

Secondary Impact Assessment Manual

Urban Systems Research and Engineering, Inc.
Cambridge, MA

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By

Urban Systems Research and Engineering, Inc.
Cambridge, MA 02138

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ABSTRACT

This user manual is designed specifically for the assessment of the secondary impacts of any type of new development activity. A full range of secondary impacts is considered. The manual consists of a three-level review process -- Levels A, B, and C. Within this framework projects without significant secondary impacts can be screened early in the environmental assessment process; the user need not resort to a full EIS in every case. Intended users of this manual are the EPA regional offices, state environmental review agencies, contractors for these agencies, and other interested parties to the environmental review process. Chapter 1 of the manual provides an introduction to the three-level framework; Chapters 2, 3, and 4 present the three levels of analysis, each of which has its own set of procedures.

Chapter 1

INTRODUCTION AND ORGANIZATION

1.1 INTRODUCTION

This document, written for EPA's Office of Environmental Review, is concerned with assessment of the secondary impacts of new source industries under the NPDES program. Structured as a user manual for EPA regional offices and other environmental review organizations, this document comprises a three-stage and progressively more detailed step-by-step procedure for assessing secondary impacts. This three-stage procedure (termed Level A, B, and C, respectively) provides two decision points at which you can reach a finding of no significant impact without producing an environmental impact statement or doing further analysis of the project. Although written in the context of EPA's new source NPDES program, the procedures discussed in this manual can be used in other environmental review programs to assess the secondary impacts of any type of facility or project.

1.2 DEFINITION OF SECONDARY IMPACTS

Secondary impacts of a project or facility are indirect or induced changes in the physical or social environment. Secondary impacts are triggered by direct (primary) impacts. For the purposes of the discussion in this manual, secondary impacts are also defined as those impacts which occur off-site from a project or any associated infrastructure (such as barge landings or rail facilities) which is an essential part of the operation of the project.

The example in Figure 1 illuminates the definition. Note that this example is hypothetical and includes only a portion of the potential primary and secondary impacts associated with a facility or project. In this example, the primary impact is the direct employment requirements of the facility. This employment demand includes both the construction and operation phases. Other primary impacts may include direct physical impacts (e.g., air or water pollution) or direct infrastructure requirements (e.g., access roads or facilities for self-generation of power).

Looking only at the direct employment impact in the example, a number of potential secondary impacts may be triggered. All of the impacts to the right of the dotted line are considered secondary impacts.

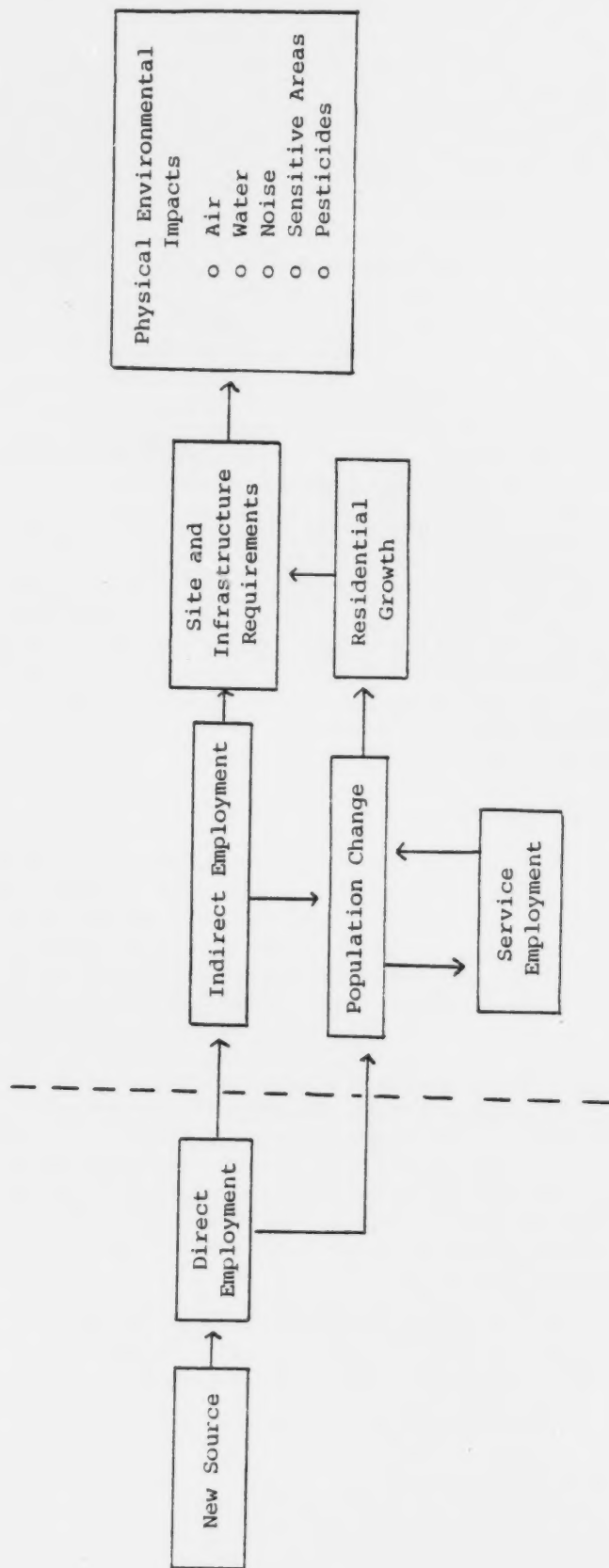


Figure 1 Hypothetical Impact Chain of a Facility or Project

There are several relevant issues involved in analyzing and measuring secondary impacts:

- successful measurement of these impacts is directly related to the quantification of the preceding impacts;
- it is important to analyze cumulative impacts. A given secondary impact (such as secondary air pollution) may be the result of several different previous impacts - the cumulative effects of all of these stimuli must be considered;
- the likelihood of secondary impacts occurring is highly dependent on the magnitude and the occurrence of the preceding impact. For example, if there is no population change in a community, then secondary physical impacts resulting from residential growth are unlikely to occur.

Figure 7 in Chapter 4 provides a considerably more detailed and complete flowchart of secondary impacts. Appendix I.J. explains Figure 7, and is designed for the reader interested in more explanation about the reasons that secondary impacts occur.

1.3 RATIONALE FOR THIS USER MANUAL AND FOR LEVELS A, B, AND C

A major goal of this user manual is to increase the perception on the part of EPA regional offices, state environmental review agencies, contractors for these agencies, and other interested parties that secondary impacts, in and of themselves, are important. This goal is the rationale for a user manual devoted to secondary impacts, and is also the rationale for the concept of a three-level review process devoted to these impacts alone. Although the techniques included in the user manual were conceived in light of the resources and practices of the EPA regional offices, these techniques are easily adaptable to the requirements of any user responsible for the review of secondary impacts.

The techniques in this user manual are incorporated into a three-level review process. The three-level structure is consistent with the assumption that projects without significant secondary impacts can be screened early in the environmental review process; you need not resort to a full EIS to make this determination. Each of the three levels consists of specific techniques. Briefly the three levels can be summarized in the following terms:

- Level A is a screening procedure based on a brief set of possible questions listed in Chapter 2. These questions are suggestions of the types of issues you should raise with the applicant. The list is not a formal questionnaire to be directed to all applicants, because NEPA regulations require that you treat each facility on a case-by-case basis.

Level A is designed to screen, based on four specific criteria given in Chapter 2, those projects which definitely will have no significant secondary impacts. If there is any doubt on your part about the potential for these impacts, a Level B or C analysis is required.

The output of Level A is part of an environmental assessment supporting the finding of no significant (secondary) impact, in those cases where the Level A analysis results in this decision, or a brief internal memorandum stating the need for further analysis of the project.

- Level B analysis is directed to a community audience and focuses primarily on socioeconomic impacts. We recommend that the data for this analysis be supplied primarily by the applicant or readily available published data sources, thereby significantly reducing the burden upon the reviewer.

In those cases where the Level B review is being carried out by an EPA regional office, data collected from the applicant or from these published sources can be organized in the form of an Environmental Information Document.

At Level B, quantification of socioeconomic impacts is required, but quantification of secondary physical impacts is not required. However, at Level B, you should do a qualitative review of air, water, and sensitive area impacts, focusing on issues such as local controls over sensitive area development, and the present air and water quality situation in the impact area. If the Level B criteria indicate that there are potential effects of the project sufficient to require an EIS, then secondary physical impacts can be treated in considerable detail, with quantification, at Level C.

The output of Level B is a short paper which quantifies socioeconomic impacts, and which points out any potential secondary physical impacts resulting from residential growth. Ideally, this paper, which can be part of an environmental assessment, requires a limited effort on your part to modify information provided primarily by the applicant or from published sources.

- The principal product of the Level C analysis is that section of an environmental impact statement devoted to the secondary impacts of the new source. This analysis will cover both socioeconomic and physical secondary impacts. The effort required on your part to carry out the Level C procedures

is consistent with recent current practices concerning the preparation of EISs by the regional offices, regional office contractors, and state review groups, and is also consistent with the intent of CEQ to have EPA and other agencies produce environmental impact statements which are "analytic, rather than encyclopedic," with "impacts discussed in proportion to their significance."*

1.4 SCOPE OF THIS MANUAL

Each user of this manual should be aware of its limitations and intended uses. This manual was written under the sponsorship of EPA's Office of Environmental Review. It is intended that this manual be used solely for assessment of the secondary impacts resulting from the location of new facilities. Although written under a contract concerned with new source facilities for which an NPDES permit is being sought, the techniques in this manual have wider application to all types of projects undergoing environmental review, and we encourage this use of the manual. However, although there are techniques in this manual that are relevant to the assessment of primary (direct) impacts, we do not intend that the techniques be used for that purpose.

This manual is designed to be used for assessment of secondary impacts. This is not a manual of mitigation measures.

The appropriate users of this manual are the enforcement branch and environmental impact branch of the EPA regional offices; state and local agencies responsible for environmental review; interested parties to the review process; and any firms or individuals under contract to prepare an environmental impact statement for a new facility. All of these parties can benefit from the procedures given in this manual.

An underlying assumption of this manual is that, although the secondary impacts of a project can be significant, it is appropriate, given resource constraints on the part of EPA regional offices and other users, to assess these impacts using less complex, yet accurate, techniques. The reliance on simplifying assumptions and rules-of-thumb is consistent with the limited resources available to the regional offices and other prospective users, and should increase the utilization of this manual.

In preparing this manual, we reviewed existing mathematical models and other methodologies for secondary impact assessment.** This review included gravity models for the allocation of residential growth, cohort-survival models for the analysis of labor force availability, and boomtown models for

*40 CFR 1502.2(a) and (b).

**Urban Systems Research & Engineering, Inc. "Induced Impacts of New Source Industries: Study and EIS Preparation Manual Development," Report #5--Review of Modeling Literature, for Office of Federal Activities, U.S. Environmental Protection Agency, September 6, 1979.

the study of the problems of rapid growth in smaller communities. In general, no comprehensive model or methodologies for assessing secondary impacts from the siting of new facilities exist. The existing techniques typically provide an exceedingly detailed analysis of a single or small group of secondary impact areas, and are inappropriate as substitutes for the specific procedures in this manual. Therefore, although you may wish to substitute specific methodologies for selected impact areas, we do not recommend this approach.

1.5 ORGANIZATION OF THIS MANUAL

The next three chapters of this manual are devoted respectively to Levels A, B, and C, the purposes of which have been briefly discussed in this chapter. Throughout each chapter examples, incorporated into figures or tables, are used to explain specific techniques or problems. These figures and tables supplement the text, and are not meant to interrupt it.

The appendices provide information integral to the user manual; this information has been put at the end of the manual to enhance its readability. Included are detailed examples of specific procedures, tables of infrastructure standards, and other elements which are important, but too lengthy to be easily incorporated into the body of the manual. Reference is made to these appendices throughout the next three chapters.

Chapter 2

LEVEL A ANALYSIS

2.1 INTRODUCTION TO LEVEL A ANALYSIS

The purpose of Level A is to determine whether new residential development will be required to accommodate the direct and indirect employment demands of the facility. The major elements of the Level A analysis include (see Figure 2):

- an initial telephone or mail contact with the applicant
- an initial meeting with the applicant
- a request by the reviewer that the applicant complete preliminary application materials.⁽¹⁾ These materials should include information about some of the issues raised by the questions shown in Figure 3. Figure 3 is not a formal questionnaire to be answered by all permit applicants.
- a decision by the reviewer as to whether the applicant's facility qualifies as a new source.
- a decision either 1) that additional, more detailed analysis of the new source application is required to determine potential secondary impacts, or 2) that construction or operation of the new source will result in no significant impacts, in which case an environmental assessment must be written to support this finding. The criteria for these decisions are outlined below.

2.2 STEP 1: SUGGESTED LEVEL A SCREENING QUESTIONS

The preliminary application materials typically requested of new source applicants are often oriented toward primary, rather than secondary, impacts. To provide a proper basis for the assessment of secondary impacts, we have provided a list of possible questions in Figure 3.

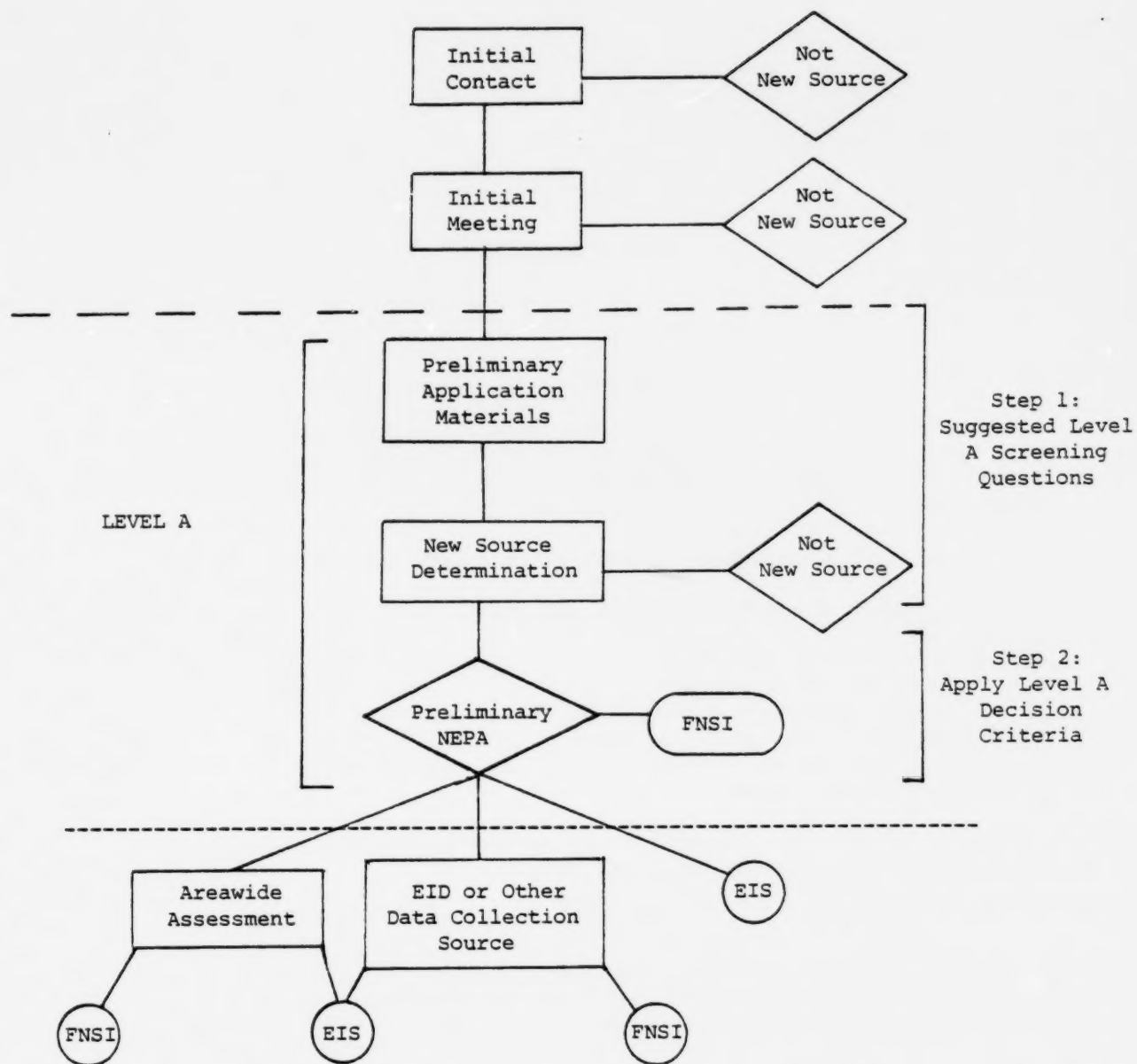


Figure 2. Flowchart of Level A Activities

FNSI = finding of no significant impact
 EIS = environmental impact statement
 EID = environmental information document
 Areawide assessment - see glossary

We are not proposing a formal standardized Level A questionnaire because current NEPA regulations require that facilities be treated on a case-by-case basis. This implies that a formal, structured questionnaire to be answered by all applicants is inappropriate for the initial assessment of potential secondary impacts.

The questions in Figure 3, therefore, are meant to suggest information that you should obtain from the applicant or from other sources noted in the questions. We recommend that, for each facility, you consider the issues raised by the questions.

On May 19, 1980, EPA issued consolidated permit program requirements⁽¹⁾ governing the Hazardous Waste Management program under the Resource Conservation and Recovery Act (RCRA), the Underground Injection Control Program under the Safe Drinking Water Act, the Prevention of Significant Deterioration (PSD) Program under the Clean Air Act, and the National Pollutant Discharge Elimination System Program and State Dredge or Fill ("404") programs under the Clean Water Act. These requirements include specific forms that are to be used by EPA and State agencies who are requesting information from permit applicants. Questions 1 and 3 in Figure 3 are consistent with the consolidated permitting requirements. The other questions in the Figure are necessary to properly screen for secondary impacts, but these questions do not conflict with and are also consistent with the consolidated permitting requirements.

Reference is made throughout the questions to the impact area. The impact area at Level A is defined as the county containing the new source facility (the 'host county'), and any county contiguous to the host county. This definition is simple, but provides a reasonable approximation of the impact area, consistent with the initial screening function of Level A.

Note that Questions 2, 3, and 4 in Figure 3 are concerned with a geographic area more limited than the impact area, as defined above. These three questions are concerned only with the more immediate area around the site of the facility. Questions 2 refers particularly to an area (the area of operation) within a mile of, and including, the facility, whereas Questions 3 and 4 refer to a larger area within five to 10 miles of, and including, the facility.

The 23 questions in Figure 3 are intended to focus on the potential for secondary impacts, although these questions may also serve to screen for potential primary impacts. We have developed this list of possible questions for screening secondary impacts because 1) there is often little or no comprehensive assessment of these impacts by environmental reviewers, and b) secondary impacts alone may be sufficient grounds for denying a permit.

These questions are not unduly difficult for the applicant to answer. Some of the information required does presuppose that the applicant has made

¹⁾ 40 CFR 122 to 125.

Figure 3

PROPOSED QUESTIONS FOR SCREENING POTENTIAL SECONDARY IMPACTS (LEVEL A)

1. What is your Standard Industrial Classification number? If more than one SIC applies to your facility, list up to four in descending order of importance.
2. Submit a topographic map of the proposed operation area; this map should extend at least one mile beyond property boundaries. The suggested source for this is a USGS topographical map (1:24,000 scale). You should include the following information on the map:
 - a) the outline of the facility
 - b) the location of each of its proposed and existing intake and discharge structures
 - c) the location of each hazardous waste treatment, storage, or disposal facility
 - d) the location of each well where fluid is injected underground
 - e) the location of all springs, rivers, and other surface water bodies in the map area.
3. Check the categories which best describe the area surrounding the site on which the proposed facility will be constructed, i.e., the area shown on the above map.

_____ Urban	_____ Shopping Center
_____ Suburban	_____ Industrial Park
_____ Small Town	_____ Commercial Strip
_____ Rural	_____ Housing Development
_____ Other (explain)	
4. Submit a more general location map (8-1/2 by 11 inches) which shows town and highway numbers, and which pinpoints the proposed area of operation.
5. Is your facility to be constructed near lands of 25 percent or greater slope? If this information is unknown, consult the topographical map submitted in response to Question #2 above, available from USGS.

Figure 3 continued

6. Are there any sites of historic, architectural, or archeological or cultural value within the impact area? If so, please name them. If this information is unknown, contact the Division of Cultural Resources at the regional office of the Department of the Interior and refer to the National Register of Historic Places, or contact the State Historic Preservation Officer.
7. Are there any endangered species known to inhabit the impact area? If so, name them. If this information is unknown, contact the Office of Endangered Species under the Office of Federal Assistance, U.S. Fish and Wildlife Service at the regional office of the Department of the Interior. Refer to the Federal Register of Endangered Species. Information on marine species may also be obtained from the Office of Marine Mammals and Endangered Species of the National Marine Fisheries Service, which operates under the National Oceanic and Atmospheric Administration.
8. Does the impact area contain a State or federally designated wild and scenic river, or one authorized for further study? If so, please name that river. If this information is unknown, please contact the Heritage Conservation and Recreation Service of the regional office of the Department of the Interior.
9. Does the impact area contain a local, state or Federal recreation area? If so, please name them. If Federal recreation areas are unknown, contact the National Park Service of the regional office of the Department of the Interior.
10. Does the impact area contain wetlands or floodplains? If so, please name them. If this information is unknown, please contact the Environmental Office of the U.S. Fish & Wildlife Service of the regional office of the Department of Interior. State departments of fish and game are also a source for this information.
11. Does the impact area contain significant agricultural lands? If unknown, please contact the Soil Conservation Service at the regional office of the Department of Agriculture.
12. Is any portion of the impact area within a coastal zone? If this is unknown, contact the State Coastal Zone Management Office. (Usually a subdivision of the State Office of Environmental Affairs or Natural Resources Division.) While the state office is a preferable source of information, the Coastal Zone Information Center at the National Oceanic and Atmospheric Administration (NOAA) or the Director of the State Programs Office at NOAA also can provide pertinent information.

Figure 3 continued

13. Does the impact area contain an aquifer or other source of potable water? If this is unknown, contact the State Water Resources Division, which, in conjunction with the United States Geological Survey, broadly maps the aquifers in the state. For a more specific delineation, contact the local Board of Health.
14. Are any mandatory Class I PSD areas located in the impact area? If this information is unknown, contact a) the state air agency, and speak with an individual responsible for the state implementation plan (SIP), or b) the Air and Hazardous Materials Division of the EPA Regional Office that serves your state.
15. Is the impact area attainment, nonattainment, or unclassified in terms of meeting national ambient air quality standards (NAAQS)? If this information is unknown, contact the same sources listed under Question 14.
16. What is the expected employment of your facility when operating at capacity?
17. What is the expected employment of your facility during the peak construction phase? (See Appendix I.C and the last paragraph of Chapter 3, Section 3.8, for a discussion of possible impacts caused by construction workers.)
18. How many employees will have to move into the area to satisfy your employment requirements a) for the peak construction phase, b) for operations?
19. How many new housing units will be required to accommodate the number of employees during the peak construction period?
20. Are there any other businesses of which you are aware that are moving into the area to supply materials to or purchase products from your operation specifically?
21. Briefly describe any anticipated effects on the surrounding area from construction or operation of the facility. These effects might include, but are not limited to: changes in residential or commercial development; changes in land use; etc.
22. Briefly describe any social or economic benefits expected to result from construction or operation of the facility.
23. Are you aware of any significant public objections to construction or operation of the proposed facility? If yes, please describe these objections.

a careful site and feasibility study of the proposed facility location, and that the applicant is reasonably aware of physical and social conditions in the impact area. However, most information is obtainable from sources other than the applicant, if desired. As a screening analysis intended to require one day or less, we encourage the participation of the applicant in providing this information.

Questions 1 through 4 are designed to provide background information about the nature and location of the facility. Questions 5 through 15 are designed to determine whether there are any sensitive features which might be affected by new residential growth in the impact area. Questions 16 through 20 ask the respondent to estimate the direct and indirect employment and housing effects of the facility, and Questions 21 through 23 require that some thought be given to social or economic effects in the impact area, as well as public attitudes toward the facility.

Your primary sources of information for these questions are:

- the new source applicant
- those agencies listed in Questions 5 through 15.

Additional sources of information are:

- local economic development officials
- regional and local planning groups
- local chambers of commerce
- other sources listed throughout Chapters 2, 3, and 4.

Your reliance on these additional sources may add considerably to the time and labor required to complete Level A. Ideally, Level A should be a quick screening process which relies primarily on the applicant to supply the required information. You may, however, use any other source of information listed in this manual which you consider to be appropriate.

2.3 STEP 2: APPLY LEVEL A DECISION CRITERIA

In deciding whether to proceed to Level B or C, consider the following:

- the answer to Questions 18 and 19 will indicate whether population or new residential growth is expected from construction or operation of the facility. Any new population or residential growth could endanger the sensitive areas listed in the set of questions, or could have uncertain social or economic effects and, therefore, a Level B or C analysis is appropriate.

- if you are aware of significant public objections to the facility, a Level B or C analysis is appropriate.
- if there are other major facilities or businesses locating in the impact area -- whether related to the applicant's facility or not -- a Level B or C analysis is appropriate.
- if construction or operation of the facility is expected to result in changes in land use, such as the construction of major road facilities, the conversion of residential areas to commercial or industrial use, or the conversion of agricultural land to other uses, a Level B or C analysis is appropriate. At Levels B or C a more detailed assessment of these changes in land use can be undertaken, to consider the type, location, and timing of these changes. Factors that should be considered in deciding whether to proceed with further analysis include a) the nature and extent of the vacant land subject to increased development pressure as a result of the new source, b) the increases in population or population density which may be induced, c) the nature of land use regulations in the impact area and the potential effects of these regulations on development and the environment. If changes in land use are expected, and there is any uncertainty about the significance of these changes, a Level B or C analysis is appropriate.

If none of the above criteria are satisfied, then we recommend a finding of no significant impact (FNSI). There may, however, be significant primary impacts resulting from the facility which require further review by the user. These primary impacts are not the concern of this manual, and nothing in this manual is designed to assess them. The information required to answer the questions in Figure 3 is designed for screening secondary impacts only.

2.4 SUMMARY OF LEVEL A ANALYSIS

- Level A is the first level of analysis of the potential secondary impacts of the facility.
- the information required for Level A is shown in the form of the screening questions listed in Figure 3.
- do not use Figure 3 as a formal standardized questionnaire. Rather, use these screening questions as a summary of information needed to screen secondary impacts. Depending upon the type of facility proposed and its geographic location, you should select the information you will require for screening the project.

- the questions in Figure 3 are directed solely toward secondary impacts. Primary impacts are not considered in this manual.

Chapter 3

LEVEL B ANALYSIS

3.1 INTRODUCTIN TO LEVEL B ANALYSIS

Level B is designed primarily to quantify the socioeconomic effects of the facility, and comprises generally only a very limited consideration of secondary physical effects. The quantification of socioeconomic effects is based on multipliers calculated by the user, although we have provided default values for some steps. Level B also requires input from local sources in the impact area, such as economic development officials and realtors.

Figure 4 is a flow chart of the major steps in the Level B analysis. The principal output of this analysis is part of the assessment summary,* which supports a finding of no significant impact, or which recommends a Level C (EIS) analysis of secondary impacts.

The data required for Level B are readily available either from primary or published sources,** including the location study that the applicant may have completed for site selection. We recommend that the applicant be required to supply all applicable information, as the Level B methodology presupposes that limited resources are available to the user at this stage of environmental review, i.e., prior to the preparation of an EIS. However, independent verification of some of the information supplied by the applicant or other sources is desirable, and is discussed in the context of individual steps below.

If your resources allow you to expend more effort in tracking down data, steps in Chapter 4 (Level C) which correspond to those in Level B list additional sources.

The results of Level B analysis, incorporated into the assessment summary, are directed to a community audience, and emphasize socioeconomic effects. At

*Known as the environmental assessment in CEQ nomenclature.

**The recommended data sources are provided in the discussion of each step in this chapter.

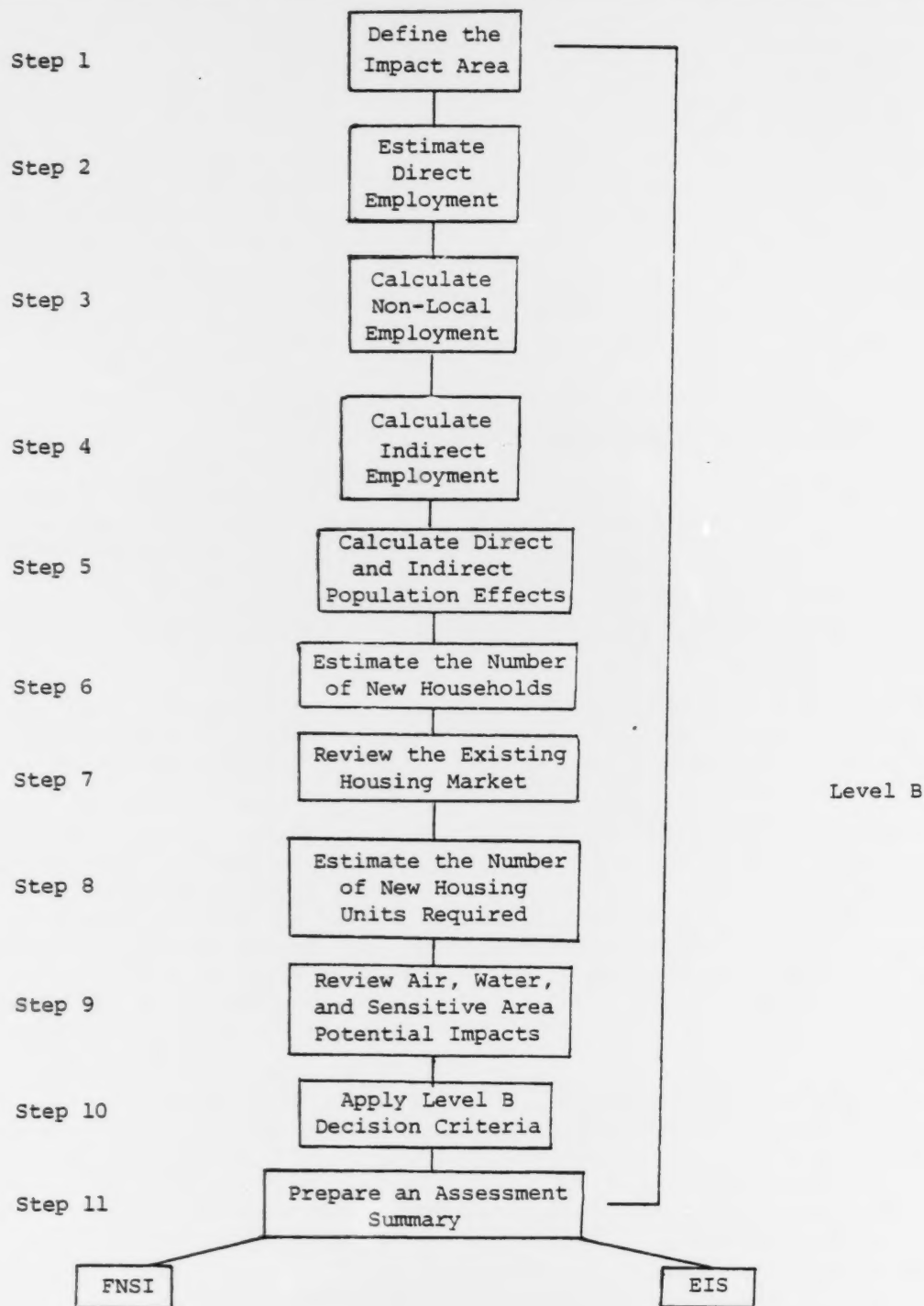


Figure 4. Flowchart of Level B Activities

an early stage in the environmental review process, a Level B analysis provides an indication of the population and employment effects of the facility. These effects are of obvious concern to interested parties in the impact area.

In addition to these socioeconomic effects, you are required to do a qualitative review of secondary air, water, and sensitive area (i.e., physical) impacts. This analysis of physical impacts does not rely on complex quantitative techniques. If the Level B criteria indicate that a Level C analysis is appropriate, then secondary impacts can be quantified and treated in considerable detail during the preparation of the EIS.

3.2 NOTE TO EPA REGIONAL OFFICE USERS OF THIS MANUAL

Data solicited from the applicant for Level B can be solicited in a form which corresponds to an environmental information document.

Some regional offices rely upon an areawide environmental assessment as one tool to measure the potential for secondary impacts, particularly upon sensitive areas. However, we recommend a Level B analysis in addition to any analysis based on the areawide assessment.

3.3 STEP 1: DEFINE THE IMPACT AREA

To reduce the effort required to collect the data for Level B, define the impact area along county lines, rather than sub-county government jurisdictions, as is the case at Level C. The impact area at Level B specifically includes the county containing the new source facility (the 'host county'), and any other counties in the facility's commuted area which are expected to contribute to the facility's labor pool.⁽¹⁾ Ask both the new source applicant and local economic development officials to identify these surrounding counties.

In addition to these sources, studies of the journey-to-work indicate that about 95 percent of workers travel less than 25 miles and/or 50 minutes to work. (See Step 1 of Level C, Chapter 4). Use these default values to identify those counties from which workers are expected to commute to the facility and which should, therefore, be included in the impact area.

3.4 STEP 2: ESTIMATE DIRECT EMPLOYMENT

Request the new source applicant to provide an estimate of the direct employment (E*) requirements of the project -- broken down into construction and operating workforce respectively -- for the first ten years of the project, beginning with the first year of construction. As illustrated in Table 1, display this employment profile by year. Use the table to conceptualize the time period over which lagged effects of the project will occur, and to highlight periods of particular stress on infrastructure, housing and the physical

⁽¹⁾ Recall that the impact area at Level A is defined as the county containing the facility, and any county contiguous to the host county. Therefore, the Level A and Level B impact areas often will not be the same.

environment which may occur if direct employment requirements cannot be met from the local population in the impact area.

3.5 STEP 3: CALCULATE NONLOCAL EMPLOYMENT

If the new source is expected to create E^* new jobs, as estimated in the previous step, the local⁽¹⁾ labor force may supply some of this employment. The remaining increment in employment (E) is:

$$E = E^* - E_{\text{local}}$$

Calculating the local component requires a consideration of

- levels of unemployment in the impact area
- skills required by the new source relative to those available in the impact area
- wages paid by the new source relative to prevailing wages.

Ask the new source applicant and local economic development officials to estimate this local component for that year within the ten-year period representing the maximum direct employment (E^*) of the project (from Step 2). Using the example cited in Table 1, the year of maximum direct employment is 1981. Using the local component, calculate the increment in employment (E) that must be met by new workers moving into the impact area. This represents the maximum increment for the ten-year period of analysis (E_{max}).

In using this technique, it is extremely important that you require the applicant and economic development officials to provide as much detail as is available concerning the existing communities from which the facility expects to draw both temporary (construction) and permanent (operation) local workers. It is also very important that you distinguish, with the help of the applicant and other officials, the temporary local workforce from the permanent local workforce. There are several considerations involved:

- temporary workers often are more willing to commute long distances to a work site than are permanent workers
- if a large temporary workforce is required -- and this workforce cannot be supplied locally, even allowing for those who commute long distances -- then a major influx of temporary workers is likely. Resulting impacts will happen quickly, and there will be limited time for the community to prepare for them. After a specified period of time, temporary workers are likely to leave the area, leaving behind a small, permanent workforce, the effects of which will be qualitatively different.

(1) "Local" refers to any of the counties in the impact area.

TABLE 1

PROJECT EMPLOYMENT
Warner Valley Station -- Washington County Utah

Year	Construction	Operating or Permanent Workforce
1978	1	0
1979	258	0
1980	905	0
1981	1016	0
1982	812	108
1983	146	112
1984	0	108
1985	0	108
1986	0	108
1987	0	108

SOURCE: Mountain West Research. Economic/Demographic Assessment Manual -- Current Practices, Procedural Recommendations, and a Test Case. Prepared for Bureau of Reclamation, November 1977, Contract Number 07-DR-50180, p. 212.

As a quick check on the estimate of the local component (E_{local}), you may do the following:

- (1) obtain Current Population Survey Labor Force Estimates from the Bureau of Labor Statistics (BLS)
- (2) for the counties in the impact area, extract the data for total labor force, percent of labor force unemployed, and total unemployment
- (3) although there is a one- to two-year long lag for these data, the estimate of total unemployment provides a rough estimate of the number of local individuals available to work at the new facility.

As an additional check:

- (1) ask the new source applicant or local economic development officials for the current unemployment rate in the impact area
- (2) apply this rate to the total labor force estimates from the BLS study, to obtain another rough estimate of the number of individuals available.

You should carry out Step 3 at least twice:

- (1) first for the year of maximum direct construction employment (E_c)
- (2) second for the year of stable direct operating employment (E_o); this operations year must fall within the ten-year period of analysis.

There is the possibility that the year of maximum total direct employment may be a year other than those in which either maximum construction or stable operating employment occurs. This maximum total employment will be the sum of construction and operating employment for that year. If the employment profile for the project reflects this pattern, then Step 3 should be carried out a third time

- (3) for the year of maximum total direct employment (E_k); this total employment will be the sum of construction and operations for that year. Usually, however, E_k will be the same as either E_c or E_o .

E_c and E_o will represent the employment increment at peak construction and stable operations, respectively. E_k , if calculated, will represent the employment increment at peak (total) employment. You should use these estimates to carry out steps 4, 5, 6, 8, and 9. Each of these steps should be repeated for the peak construction, stable operations, and (if different), peak total employment.

3.6 STEP 4: CALCULATE INDIRECT EMPLOYMENT

This step involves the calculation of a multiplier to account for the employment increment (E) of the facility. This multiplier is applied to the employment increment (E) estimated in Step 3 above to derive total direct and indirect employment (E_T) attributable to the facility.

Explanation of Procedure

For any type of employment (T), there is an associated population (P, number of persons per worker) which is defined by the constant, α , where

$$\alpha = P/T \quad (2)$$

Furthermore, non-basic employment (S, defined below) is linked to population,

$$\beta = S/P \quad (3)$$

The total direct and indirect employment (E_T) impacts of the facility are:

$$E_T = \frac{E}{1-\alpha\beta} \quad (4)$$

A more detailed derivation of equation (4) is given in Appendix I.A.

To calculate the ratios in (2) and (3) above, data on employment by major economic sector (Table 2) and population are required. Obtain these data for the most recent year available, but in every case population and employment data should be for the same year.

Population data are available from the Bureau of the Census, Current Population Reports, Series P-26, which is part of the Federal-State Cooperative Program for Population Estimates. A report is issued annually for each state and for counties within each state.

Employment by the major sectors in Table 2 is available from the Bureau of Labor Statistics, Employment and Earnings, States and Areas. This source provides employment for each state and for 246 major labor areas. If at least half of the impact area falls within a labor area, use the data for that labor area to calculate (3). Otherwise, use state data.

Employment in agriculture is not available from the above source. For this sector, two choices are possible:

- if 1978 population data are being used, consult the 1978 Census of Agriculture. Use the figure for farm operators, plus farm labor hired for more than 150 days. These data are available on a county level, and can be aggregated to derive other geographic units.

TABLE 2

MAJOR ECONOMIC SECTORS

Agriculture, forestry and fisheries

Agriculture
Forestry and fisheries

Mining

Metal
Coal
Crude petroleum and natural gas
Nonmetallic, except fuels

Manufacturing

Food and kindred products
Textile mill products
Apparel and other fabric products
Lumber products and furniture
Paper and allied products
Printing and publishing
Chemicals and allied products
Petroleum refining
Primary metals
Fabricated metals and ordnance
Machinery, except electrical
Electrical machinery and supplies
Motor vehicles and equipment
Transportation equipment, except motor vehicles
Other manufacturing

Transportation, communications, and public utilities

Wholesale trade

Retail trade

Finance, insurance and real estate

Services

Government

Federal government
State government
Local government

- if the population figures are collected for a year other than 1978, use the 1974 or 1978 Census of Agriculture and interpolate the data for intervening years.

The Census does not include employment in forestry and fisheries. If this is a significant portion of the local economy, consult the State Division of Employment Security or Department of Commerce to derive employment in these sectors. To determine whether forestry and fisheries employment is a significant portion of the local economy, consult County Business Patterns, an annual publication of the Census Bureau. This report lists first quarter and annual payroll, and number of establishments by industry in each state, and these data can be used as a rough guide to the relative role of forestry and fishery activity in the state economy.

The calculation of the multiplier is dependent on the concept of basic versus non-basic industries.

"The reason for the existence and growth of a region -- whether it is a community or a small resource area at one extreme or a huge metropolitan or resource region at the other extreme -- lies in the goods and services it produces locally but sells beyond its borders. These "basic" activities not only provide the means of payment for raw materials, food, and manufactured products which the region cannot produce itself, but also support the service activities, which are principally local in productive scope and market areas."*

Basic industries are, therefore, those the production or output of which supplies a demand which is generated outside of the region, whereas a non-basic industry satisfies a demand generated within the region,

Practically speaking, however, deciding whether employment in an economic sector is basic or non-basic is difficult. As a rule-of-thumb, the employment in the following industries is always considered basic:

- agriculture, forestry, and fisheries
- mining

and employment in these sectors is always non-basic:

- construction
- transportation, communications and public utilities
- retail trade
- services

*Isard, Walter. Methods of Regional Analysis: An Introduction to Regional Science. The MIT Press, Cambridge, Massachusetts, 1960.

- local government
- finance, insurance, and real estate.

Employment in the four remaining sectors may be either basic or non-basic:

- manufacturing
- wholesale trade
- Federal government
- State government.

The method for determining the basic or non-basic nature of these sectors is a location quotient. This is explained in Table 3, which provides a sample calculation for Steps 4 and 5.

After the allocation of employment to basic and non-basic components is completed, non-basic employment (S) is divided by population (P, equation (3)), and total direct and indirect employment (E_T) is calculated (Equation (4)).

Consult Figure 5 for a detailed example of this procedure.

3.7 STEP 5: CALCULATE DIRECT AND INDIRECT POPULATION EFFECTS

This step relies upon equations (2) and (3) to derive the total population impact attributable to both the direct and indirect employment (E_T) caused by the new source. This population effect (P_T) is defined:

$$P_T = \frac{\alpha E}{1 - \alpha \beta} = \alpha E_T \quad (5)$$

Appendix I.A provides more detail concerning this equation. Figure 5 provides an example of its application.

3.8 STEP 6: ESTIMATE THE NUMBER OF NEW HOUSEHOLDS

To calculate the number of housing units necessary to accommodate the new population (P_T) in the impact area, estimate the number of households implied by this population. The simplest method is to use a coefficient of average household size (H_{av}), to calculate the number of households (HH),

$$HH = P_T / H_{av} \quad (6)$$

Since 1950, average household size nationally has declined steadily from 3.37 to 2.86 in 1977.* A coefficient of 2.85 to 2.95 is a reasonable default value.

*U.S. Department of Commerce, Bureau of the Census. Statistical Abstract of the United States, 1978, p. 43.

This example utilizes Albany-Schoonhoven-Troy, under the assumption that a major portion of the impact area falls within this major labor area. The 1978 data are used. Table 3 details the data required to calculate the ratios in equations (2) and (3) of this chapter. The columns show the following:

- (1) 1978 employment (in thousands) by sector in Albany-Schoonhoven-Troy,
- (2) the ratio of this employment to total employment in Albany-Schoonhoven-Troy,
- (3) 1978 employment (in thousands) by sector in New York State,
- (4) the ratio of this employment to total employment in New York State,
- (5) the location quotient, which represents column (2) divided by column (4),
- (6) and (7) the employment in column (1) is allocated to one of these two columns, depending on whether the employment is basic or non-basic. In Section 3.6 we stated that some sectors are always basic or non-basic, and there is therefore no need for a location quotient to make this decision. These sectors are denoted as "B" or "NB" on Table 3. Columns (2), (4), and (5) therefore read N/A for these sectors. For all other sectors, a location quotient must be calculated. These sectors are denoted as "mixed" on Table 3.

To calculate this quotient, you must compare employment in the region most closely approximating the impact area (R_A) to either state or national employment data (R_B). R_B will be based on state data if R_A is either a major labor area, an SMSA, or an aggregation of county or community data. At Level B, R_A may be the state, if the impact area does not fall within one of the major labor areas listed in Employment and Earnings, in which case R_B should rely on national data. Thus, for example, the calculation of a location quotient for Eastport, Maine, would utilize data for the State of Maine (R_A) and the United States (R_B) respectively at Level B, and for the communities in the impact area (R_A) and the State of Maine (R_B) respectively at Level C. The use of more detailed data at Level C reflects the greater resources available for and effort appropriate to the preparation of an EIS, as the collection of community-level data can be difficult, and is in any case not appropriate for Level B.

The concept behind the location quotient is as follows: if the quotient is greater than 1.0, it is assumed that the industry is basic, i.e., that it

Figure 5. Sample Calculation of Indirect Employment and Population Impacts

is producing in excess of local needs and is satisfying a demand external to the region. Conversely, if the ratio is 1.0 or less, the industry is producing at or less than local requirements, may be a net importer, and is in any case responding only to internally-generated demand.

It should be noted that "other manufacturing" includes all manufacturing not specifically included in the remaining manufacturing categories, including:

- stone, clay, and glass products
- instruments and related products
- rubber and miscellaneous plastics products
- leather and leather products
- miscellaneous manufacturing industries.

As illustrated in Table 3, employment data are not always available for each of the second-level sectors in manufacturing. This is particularly true for major labor areas, few of which are expected to have employment in all economic sectors. You must be aware, then, that the data may be more aggregate than shown in the table.

The following is a step-by-step calculation of total direct and indirect employment and population attributable to the new source.

- (1) The peak employment of the new source (E^*) is expected to be 90 construction and 10 operation workers. Of this requirement, all but 50 workers will be supplied locally (E_{local}). Therefore, the employment increment (E),

$$E = E^* = E_{local}$$

is 50 persons.

- (2) The population (P) of Albany-Schoenectady-Troy as of July 1, 1978 was 792,300. Total employment (T) in all sectors in 1978 was 331,900. Therefore, the population-employment ratio (α).

$$\alpha = \frac{P}{T} = \frac{792,300}{331,900}$$

is 2.39.

- (3) Based on the analysis in Table 3, non-basic employment (S) in Albany-Schoenectady-Troy in 1978 was 228,600. Population (P) was 792,300. Therefore,

$$s = \frac{S}{P} = \frac{228,600}{792,300} = .29$$

- (4) The total direct and indirect employment impacts E_T ,

$$E_T = \frac{E}{1 - \alpha\beta} = \frac{50}{1 - (2.39 \times .29)}$$

are 162 persons, and the implicit employment multiplier is $162/50 = 3.24^*$.

- (5) The total direct and indirect population impacts (P_T),

$$P_T = \frac{\alpha E}{1 - \alpha\beta} = \alpha E_T = 2.39 \times 162$$

is 387 persons.

Repeat this analysis for the year of stable operating workforce, i.e., after construction is completed. Also repeat this analysis for the year of maximum total direct employment, if it is different from either of the two years already considered.

*There are projects which have a large and extremely short-term peak construction employment relative to the stable operations workforce. In these cases, the calculated employment multiplier may overstate the short-term effects, because economic activity will not expand to the degree that the multiplier indicates for such a short-term peak. The implicit multiplier should, therefore, be scaled down to account for the short-term nature of this peak. In boomtown situations, the implicit multiplier typically will range from 1.2 to 1.5, and this is a reasonable default value range for projects that meet the types of conditions described above.

Table 3

CALCULATION OF EMPLOYMENT MULTIPLIER FOR ALBANY-SCHENECTADY-TROY, 1978

	Albany-Schenectady-Troy		New York State		Location Quotient	Albany-Schenectady-Troy	
	(1)	(2)	(3)	(4)	(5)	Basic (6)	Non-Basic (7)
Agriculture, Forestry and Fisheries (B)	1.3	N/A	43.9	N/A	N/A	1.3	
Mining (B)	0.2	N/A	6.3	N/A	N/A	0.2	
Construction (NB)	10.7	N/A	197.5	N/A	N/A		10.7
Manufacturing (Mixed)							
Food & Kindred Products	6.0	.018	97.7	.014	1.29	6.0	
Textile Mill Products	4.2	.013	42.2	.006	2.16	4.2	
Apparel & Other Fabric Products	3.3	.010	184.7	.020	.50		3.3
Lumber Products & Furniture	-0-	--	38.4	N/A	N/A		
Paper & Allied Products	3.4	.010	52.3	.008	1.25	3.4	
Printing & Publishing	3.8	.011	151.0	.021	.52		3.8
Chemicals & Allied Products	4.9	.015	73.6	.010	1.50	4.9	
Petroleum Refining	-0-	--	8.3	.001	N/A		
Primary Metals	4.4	.013	56.5	.008	.65		4.4
Fabricated Metals & Ordinances			84.1	.012			
Machinery, except Electrical		.075	167.3	.024			
Electrical Machinery & Supplies			155.1	.022			
Motor Vehicles & Equipment	24.9		41.4	.006	1.29	24.9	
Transportation Equipment, except Motor Vehicles			39.1	.006			
Other Manufacturing	7.7	.023	291.3	.041	.56		7.7
Transportation, Communications and Public Utilities (NB)	15.5	N/A	429.3	N/A	N/A		15.5
Wholesale Trade (Mixed)	16.7	.050	441.0	.062	.080		16.7
Retail Trade (NB)	49.8	N/A	1012.0	N/A	N/A		49.8
Finance, Insurance & Real Estate (NB)	14.9	N/A	585.0	N/A	N/A		14.9
Services (NB)	65.0	N/A	1008.6	.223	N/A		65.0
Government							
Federal Government (Mixed)	0.1	.027	102.1	.023	1.17	0.1	
State Government (Mixed)	49.3	.180	230.3	.034	4.35	49.3	
Local Government (NB)	16.8	N/A	900.5	N/A	N/A		16.8
	311.9		7068.7			103.3	228.6

B = Basic

NB = Non-basic

Mixed = either basic or non-basic, depending upon the location quotient

Some observers have argued that construction workers typically do not bring their families with them to the impact area, that they typically head households smaller than the average cited above, or that they are disproportionately single relative to the general population. In addition, some studies suggest that construction workers are willing to commute much further than other workers, in order to avoid the necessity to either leave or move their families. The evidence is sufficiently contradictory; it is reasonable to state that 200 to 300 people will accompany every 100 construction workers who move into the impact area.* This ratio is consistent with the average household size assumption above, and is also consistent with the population-employment ratio in equation (5).

3.9 STEP 7: REVIEW THE EXISTING HOUSING MARKET

Consider all of the counties in the impact area as a single housing market. If there are vacant units in this market (either owner or rental), the new households (HH, derived from P_T) will be allocated to them.

Because of a lack of generalizable data concerning housing preferences, no rules-of-thumb are available to allocate the incoming population to housing of specific characteristics. It is assumed that housing preferences are adaptable in the short-term, i.e., that the incoming population will settle in the available existing housing to the extent possible.

Identifying the number of vacant housing units by county in the impact area is a difficult task, if the procedures are to be consistent with the limited resources allotted to Level B. The following steps are required:

- a) Analyze the number and composition of housing units in the impact area using the most recent U.S. Census of Housing. A volume entitled "General Housing Characteristics" is available for each state. Each volume provides data for counties, and for places of 1,000 inhabitants or more.
 - For counties, extract the information on "total housing units", and "vacant for sale only or for rent." No data on composition of these units are provided (i.e., single-family, etc.).
 - For places of 1,000 to 2,499 inhabitants, extract the same information as for counties. Again, housing composition is not given.
 - For places of 2,500 or more inhabitants, extract the data for "all year-round housing units", "vacant year-round units", and "units in structure." Table 4 shows the 1970 data for Batavia, New York. Note that the data cover the composition of the housing stock (single-family, multi-family, mobile home or trailer) with the exception of group quarters.

*See Appendix I.C for a brief summary of construction worker case studies.

TABLE 4

EXTRACT FROM 1970 CENSUS OF HOUSING FOR BATAVIA, NEW YORK

	Number
All year-round housing units	5,867
Vacant year-round units	197
Units in structure	
All year-round units	5,867
1	3,584
2 or more	2,280
Mobile home or trailer	3
Owner-occupied	3,717
1	3,179
2 or more	536
Mobile home or trailer	2
Renter-occupied	1,953
1	351
2 or more	1,601
Mobile home or trailer	1

SOURCE: U.S. Bureau of the Census. Census of Housing: 1970, "General Housing Characteristics", Final Report (HC(1)-A34), New York.

Although the Census information may be quite old, use it to provide an initial estimate of the amount and type of available housing in the impact area. In areas of high growth, these figures at least provide a base from which current housing can be estimated.

The vacancy information provided by the Census in the above source, although not current, provides an indication of the number of vacant units that might be available relative to the total number of available housing units.

Precise local vacancy data are not readily available. Nationally, recent vacancies in year-round units (for rent and for sale) have averaged around 2.5 percent.* This may translate to a significant number of units depending on the available housing stock, e.g., in an area of 100,000 units, 250 will be vacant at this rate.

Although some of these units may be substandard and presumably unsuitable for year-round habitation by the incoming population, it is appropriate to assume that, in periods of high demand for housing, a vacancy rate of virtually zero is achievable. There is no compelling evidence in the literature to document a 'structural vacancy rate', i.e., a level of vacancy which cannot be overcome no matter how high the demand for housing.

Practically speaking, vacancy rates vary significantly by locality. The 1970 data for New York show that vacancies range from 3.1 percent inside SMSAs to 8.8 percent outside, and from 3.0 percent in urban areas to 9.2 percent in rural areas, and that they show a similar range for individual places in the state. Therefore, a local estimate of housing vacancy rates is essential.

- b) Contact three to five realtors serving the counties in the impact area. These realtors may be identified by community using the National Roster of Realtors,** a standard reference publication. These realtors may also be identified through the local economic development board or the local chamber of commerce.

Provide these realtors with the number of households represented by the incoming population that corresponds to the maximum direct and indirect employment of the new source (HH, from Step 6). Ask these realtors if this number of vacant units is currently available in the realtor's community or in surrounding communities within the impact area.

As a check against the estimate of housing adequacy, ask for a current housing vacancy rate (rental vs. owner, if available). Apply this rate to the number of housing units from Step 7a to derive a rough estimate of the number of

*U.S. Bureau of the Census. Current Housing Reports, Series H-111.

**Stan Mats Communications, Inc. 427 Sixth Avenue, S.E., Cedar Rapids, Iowa (319) 364-6032.

vacant units.

Particularly for large projects, the applicant's site selection study may contain a recent analysis of the housing market, including a current estimate of the number of vacant available units.

3.10 STEP 8: ESTIMATE THE NUMBER OF NEW HOUSING UNITS REQUIRED

Discussions with realtors will indicate either that sufficient vacancies currently exist to accommodate the new households, or that a housing shortfall is probable. If the realtor indicates that insufficient units are available, ask for an estimate of the number of available units, from which the shortfall can be deduced. Similarly, having derived the number of vacant units using vacancy rate information, another estimate of the shortfall can be derived.

The difference between the number of new households (from Step 6) and the number of vacant units (from Step 7) represents the number of new units required for the incoming population. Regardless of whether there are already plans to construct this housing, and regardless of recent trends in new construction, the fact that these units do not currently exist is a sign of potentially significant housing and infrastructure problems in the impact area, as well as secondary physical impacts resulting from this new growth.

3.11 STEP 9: REVIEW SELECTED PHYSICAL IMPACTS

It is desirable to evaluate secondary physical impacts at Level B, without resorting to the quantification of these impacts required for the preparation of an EIS (Level C, Chapter 4). This step concentrates particularly on air, water, and sensitive area impacts, and comprises a qualitative assessment of these issues.

Sensitive Areas

At Level A, you will have asked specific questions of the applicant (see Figure 3) in order to identify sensitive areas in the impact area. Review the answers to these questions, and use these answers as the basis for a rough estimate of the percentage of the total acreage in the impact area which is represented by sensitive lands. Determine whether there has been recent development in sensitive areas, and also whether there are any controls over this type of development. The best source for this information is the local planning board or a regional planning group. You may obtain a recent land use map of the impact area -- the contents of these maps and probable sources for these maps are discussed in Section 4.15, Level C.

Air and Water

You should obtain the relevant State Implementation Plan (SIP) and 208 Plan for the impact area, and review them for information concerning the current air and water quality situation, e.g., location of major receiving waters, trends in air and water quality in recent years, pressures on air and water quality due to recent development activity, etc. The source for these reports is the

areawide water quality management agency, and the state air pollution control board or department of environmental affairs.

Some local jurisdictions produce their own SIPs or water quality management plans. Consult the local or regional planning agency.

If you obtain a local land use map to identify and analyze sensitive areas, use it also to identify areas where the water quality may be affected by secondary development.

You should relate any potential secondary effects of the project -- as identified in the previous steps of Level B -- to the primary effects of the project, as well as to the current air and water quality situation. For example, significant secondary growth in a nonattainment area will negatively affect efforts to achieve compliance with air quality standards. Similarly, whereas the primary air and water effects of a facility may be obvious and steps may be undertaken to deal with them, the secondary effects may have received no consideration, and may be unmanageable without additional mitigation measures.

You must never permit or otherwise give approval to any facility if the facility does not conform to the State Implementation Plan (SIP) that applies to the impact area.* The Level B qualitative analysis of air impacts may not be sufficient to determine this conformity, in which case you should go to Level C for further analysis of the air quality impacts of the facility.

3.12 STEP 10: APPLY LEVEL B DECISION CRITERIA

1) If no new housing units are required in the impact counties, assume that additional infrastructure will not be required, that commercial development will be quite limited, and that secondary physical impacts will not occur. The recommended decision under these circumstances is a finding of no significant (secondary) impact (FNSI).

2) If, however, new housing units are required to house new households associated directly or indirectly with the new source, you must make a determination about the implications of this growth. We suggest the following rule-of-thumb:

If the number of new housing units represents at least a 5 percent increase in the number of housing units in the impact area, preparation of an EIS is highly recommended. In this context, new housing units include conversion of quarters not previously offered as habitable to the civilian population. This recommendation is based on the potential for infrastructure overcrowding, as well as the potential for secondary physical impacts arising from mobile and stationary source emissions, the pressure on sensitive areas from the land requirements of residential growth, and other effects discussed fully in Chapter 4. Regardless of the size or characteristics of the impact area, a five percent increase in the housing unit base is substantial.

*Clean Air Act, s. 176(c).

3) If there is new housing growth expected which represents less than 5% of the existing base and

- there are sensitive areas adjacent to or within the site
- some of these sensitive areas have been or are soon to be developed
- there are few or no controls over sensitive area development,

go to level C.

4) If there is new housing growth expected which is less than 5% of the existing base, and if there are other known major facilities or businesses locating in the impact area, go to Level C. Consult the applicant and local economic development officials to determine if other major facilities are known to be moving into the area.

5) If there are significant public objections to the facility, and if any new housing growth is expected, go to Level C.

6) If there is new housing growth expected which is less than 5% of the existing base, and the impact area is nonattainment or in close proximity to a Class I area, go to Level C.

Be cautious in applying the last four criteria. You should not, for example, go to Level C if only five or ten units are to be constructed (provided this is less than a 5% cutoff), given the probable error associated with the estimate of new housing. In most cases, the magnitude of new housing -- in those cases where it is required -- will be so great that preparation of an EIS is an obvious step.

3.13 STEP 10: PREPARE AN ASSESSMENT SUMMARY

The principal output of Level B is a short paper* which quantifies the socioeconomic impacts of the project and which contains either a recommendation for a Level C analysis (an EIS) or a finding of no significant impact.

Specifically, this paper should include:

- an estimate of the direct construction and operating employment of the facility for the first ten years (Step 2).
- an estimate of the maximum direct employment (E*) of the project during peak construction, peak operations within the ten-year period of analysis, and (if different), peak total employment within the ten-year period of analysis (Step 2).

*In the EPA Regional Office, this short paper would correspond to part of the environmental assessment.

- an estimate of the portion of this maximum direct employment that will be supplied locally (E_{local} , Step 3)
- an estimate of the net employment increment (E) during these periods of maximum direct employment (Step 3)
- an estimate of the indirect and induced employment (E_T , Step 4) and population (P_T , Step 5) attributable to the employment increment (E)
- an estimate of the number of households (HH) represented by this new population (Step 6)
- an estimate of the number of new housing units, if any, required in the impact area to accommodate these households (Steps 7 and 8)
- an identification of potential dangers to sensitive areas, and air and water quality, posed by any new housing units, or associated infrastructure (Step 9).

In general, physical impacts receive a limited consideration in Level B, because of the difficulty of devising simple, yet accurate, techniques which require limited time and labor.

We recommend that the Level B paper (the assessment summary for secondary impacts) be no longer than one to three pages, and that it be incorporated as part of the environmental assessment. Level B should take no longer than two to three days total. An example of an assessment summary for a hypothetical project is provided in Figure 6.

EXAMPLE OF AN ASSESSMENT SUMMARY FOR SECONDARY IMPACTS*

(The following discussion represents a hypothetical case)

The impact area of the proposed project is Quillum County; the county is geographically large enough (several thousand square miles) that the majority of construction and operating workers can be expected to have permanent or temporary residences in the county. The greatest distance from any point in the county to the project is approximately 75 miles.

Peak employment will be 2,275 workers for eight to ten months during the three-year construction phase. The stable operating workforce will be about 300.

It is estimated that about 800 of the peak employment workforce will come from Quillum County. This estimate is consistent with the high unemployment rate in the county, and the relatively low skill level required to perform many of the jobs.

Of the 300 workers required for operations, about 200 will be local workers; 100 workers who possess skills not available locally will come in from outside Quillum County.

Total direct and indirect employment attributable to peak construction will be about 2,275. Total net and indirect employment attributable to long-term operations at the project will range from 150 to 280; this estimate points up the considerable discrepancy between short and long-term effects of the project.

The number of new households short-term will be about 1,500, and long-term about 100 to 200. Based on information concerning housing availability, there are sufficient units to accommodate the number of new households attributable to the long-term effects of the project. There is, however, a severe deficiency of housing for the new households associated with the short-term construction peak. This deficiency ranges from 1,250 to 1,300 units, equivalent to about 9% of the current housing stock in the county.

Sensitive Areas

The existing wetlands, historic landmarks, wildlife refuges, and parks in the impact area will not be affected by secondary housing or commercial growth. However, the site of the project, and the possible sites of residential and commercial growth, lie entirely within a coastal zone. There is potential for significant and unpredictable effects from primary and secondary activities associated with the project. Despite the controls nominally provided by the State's CZM plan, the project is a substantial operation which may permanently alter the character of the zone.

*In preparing the assessment summary, you should emphasize the results from each step of the analysis, rather than detailing the specific calculations.

Air Quality

The proposed site and the entire impact area is a class II area. There are two Class I areas within ten miles of the site. The air quality effects of secondary residential and commercial growth, particularly for mobile sources, will be measurable in the short-term, but long-term residential and commercial growth should have a minimal effect on air quality.

Water Quality

There are not expected to be any significant secondary impacts on freshwater resources. All areas where primary and secondary activity would take place are within a defined coastal zone. This area consists of numerous islands, salt marshes, bogs, and other marine features, and it supports a diversity of habitats. There are commercially important communities of shellfish and finfish, as well as species of aquatic mammals, including porpoises and great whales. The coastline and communities are important areas for marine birds. In large part, the success of these species is attributable to the minimal human presence in the area.

The potential primary effects of the project on the coastal zone are far more significant than either the short-term or long-term effects of residential or other secondary growth. However, any residential growth in a coastal zone such as this one--which has a limited amount of current development--can have measurable deleterious effects and should be carefully evaluated. Although the town plans to revise its comprehensive land use plan to account for the potential effects of the project, we recommend more analysis of the project's secondary effects.

Conclusion

1) During the peak construction phase, there is a projected deficiency of 1,250 to 1,300 housing units, representing about 9% of the total housing base in Quilliam County. Although the company plans to bring in temporary housing, the potential effects of this deficiency require a Level C analysis. This deficiency may result in serious infrastructure overcrowding, secondary physical impacts from mobile homes, and stationary source emissions, pressure on sensitive areas, and other effects.

2) The facility site and the probable site of most secondary growth are in the coastal zone. The possible impingement of this secondary growth on sensitive coastal areas, combined with the potential primary effects of construction and operation, requires a Level C analysis.

CHAPTER 4

LEVEL C ANALYSIS

4.1 INTRODUCTION TO LEVEL C ANALYSIS

The principal output of Level C is that portion of an environmental impact statement that considers secondary impacts. Only secondary impacts are covered by the techniques in this chapter. The prospective users of these Level C techniques are the environmental impact statement preparation staffs at EPA regional offices, agencies of state and local government concerned with environmental review, regional planning commissions, contractors hired by these organizations, and others interested in the secondary impacts of any facility. This manual should also be provided to any interested applicant whose facility is subject to environmental review.

It is helpful to refer to Figure 7 while using this Chapter. Figure 7 shows the causal mechanisms for and interrelationships between secondary impacts. An explanation of this flow chart is provided in Appendix I.J.

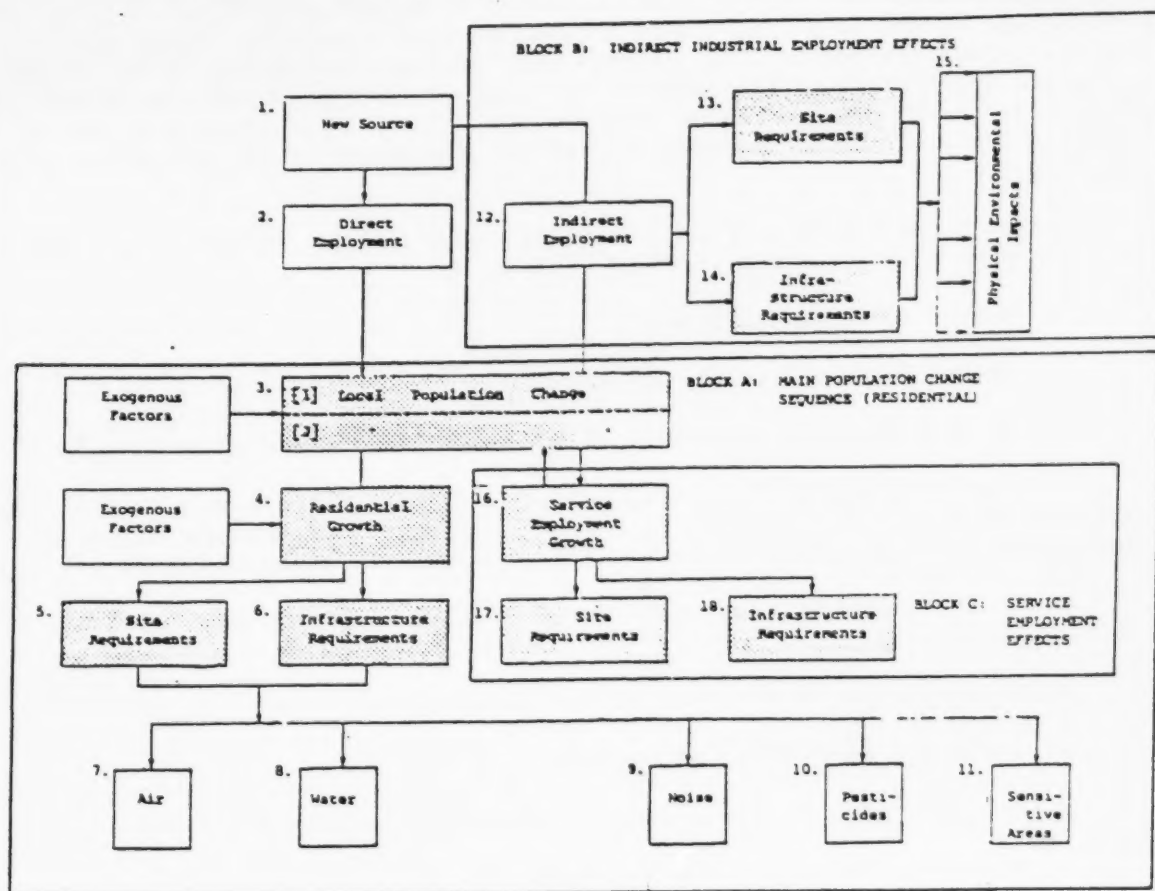
Although this user manual emphasizes the analysis of the secondary impacts of a project--from the initial receipt of the application to the preparation of an EIS--this should not be construed as an implicit statement that these impacts are more important than primary impacts. The purpose of the scoping meeting is to determine which issues and impacts are to be addressed in the EIS--these may or may not include secondary impacts.

The Council on Environmental Quality has issued "Regulations for Implementing the Procedural Provisions of NEPA."* One provision of these regulations states the following:

There shall be an early and open process for determining the scope of issues to be addressed (in an EIS) and for identifying the significant issues related to a proposed action. This process shall be termed scoping.**

* 40 CFR 1500 to 1508, effective July 30, 1979.

**40 CFR 1501.7



 - Social, economic, and resource-related impact areas. These are generally of primary concern to communities and states.

Figure 7. SECONDARY IMPACTS ASSESSMENT FLOWCHART

If the scoping process does determine that secondary impacts should be considered, the techniques in this chapter can be used to assess them.

4.2 FORMAT OF CHAPTER 4

The remainder of this chapter discusses in detail the individual techniques for assessing secondary impacts at a level of detail suitable for an environmental impact statement. The ultimate goal of these techniques is not necessarily the quantification of impacts. For some categories of impacts, either the state-of-the-art does not allow credible quantification of these impacts, or a qualitative analysis of the magnitude of and mitigation of these impacts is more appropriate.

Most of the blocks in Figure 7 are discussed below. In addition, there is a discussion of other steps required at Level C:

- defining the impact area
- describing the existing environment in the impact area
- doing a baseline projection of the impact area without the project.

The order of exposition followed in this chapter represents a logical progression of steps corresponding to the order in which the analysis should be undertaken. A flow chart of the Level C techniques is given in Figure 8.

For each assessment technique discussed below--starting with Section 4.4--there is generally

- a description of the step or area of analysis
- the data output from the analysis
- the data input to the analysis, and the sources for these data
- suggested techniques for the analysis. Several techniques may be listed, and examples will often illustrate the use of the technique.

Although techniques are discussed in this manual in a step-by-step procedural format, we assume that there will be significant initiative taken by you to supplement or adapt these techniques to local conditions, and to properly interpret the projections. We are confident that the techniques outlined are sufficiently accurate and straightforward, but there is no substitute for imaginative adaptation of these techniques.

4.3 STEP 1: DEFINE THE IMPACT AREA

The impact area comprises all communities within the normal daily commuting radius of the site where the facility will be constructed. There is potential for new residential development in these communities, as new individuals may be attracted to the commutershed to work at the facility. All other things being equal, the closer a community is to the facility, the greater the degree of the

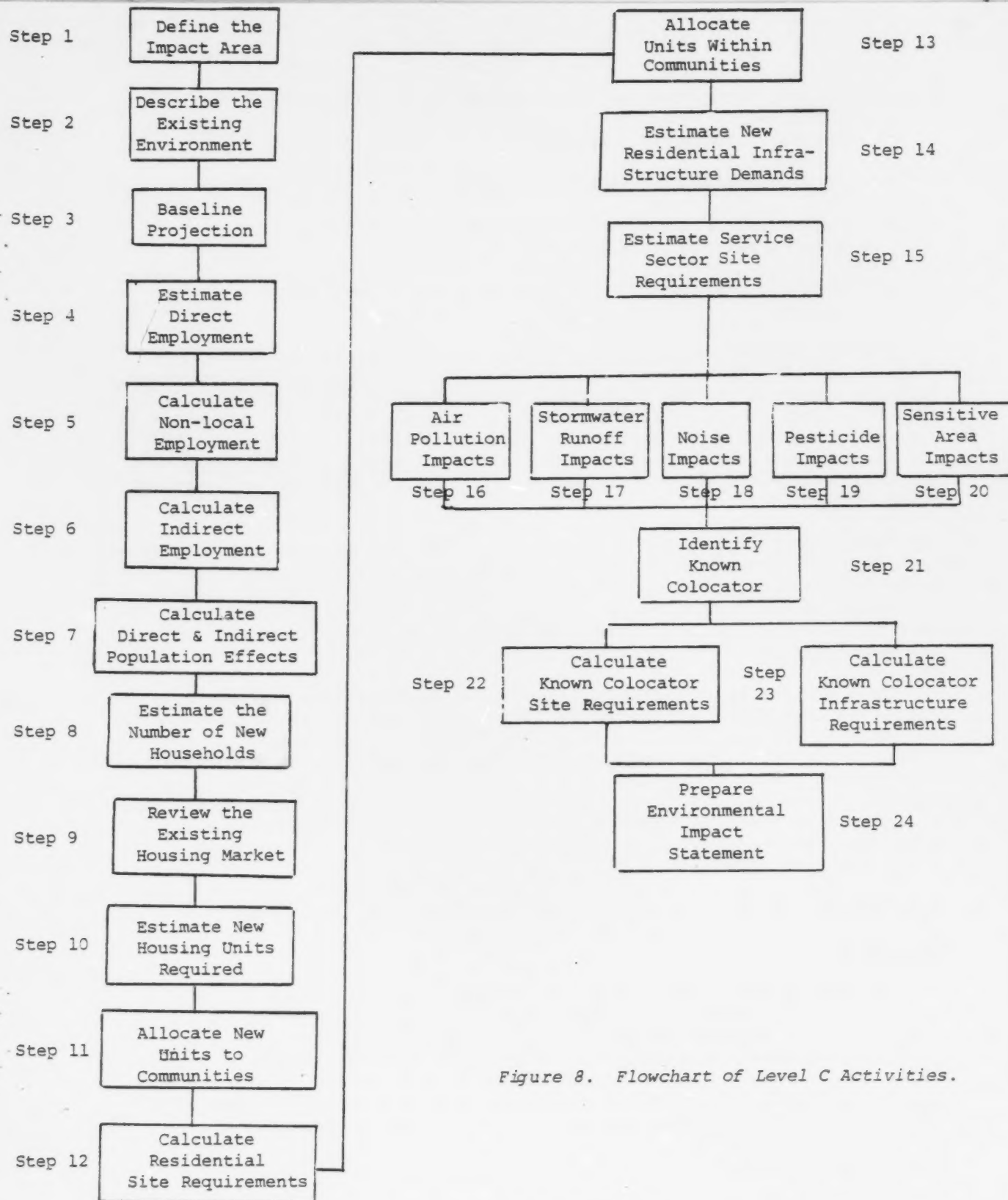


Figure 8. Flowchart of Level C Activities.

expected impact. Determine the normal commuting area by talking with:

- the local Chamber of Commerce
- the local economic development agency
- the permit applicant, who may have studied the issue prior to selecting the site for the facility
- the local division of employment security or department of labor.

You may also define the commuting area by referring to national data on distance to work (Table 5) and travel time to work (Table 6). The information given in these tables, for all workers and by means of transportation, indicates that two-thirds of all workers travel fewer than ten miles, and fewer than 25 minutes, to get to work. Information on travel to work is also collected for the sixty SMSAs which comprise the sample for the Annual Housing Survey, and you should review these data for facilities which are expected to locate within these SMSAs.

Regardless of the source used to estimate the commuting radius, the resulting impact area should be defined to include only those communities that can reasonably be expected to contribute to the facility's labor pool. Careful definition of the impact area at the beginning of the analysis can reduce the data collection burden considerably by reducing the number of jurisdictions for which data are to be collected.

There may not be a congruence between the impact area as defined above (i.e., all communities within the facility's commutershed) and the data collection area (i.e., all jurisdictions for which data are available). Although we suggest below for certain techniques that data be collected for individual communities, practically speaking you may have to rely on data for larger regional groupings, such as counties, Bureau of Economic Analysis Areas (BEAs), or standard metropolitan statistical areas (SMSAs). The use of these different groupings requires judgment on your part to adapt the data as required to reflect local conditions.

4.4 STEP 2: DESCRIBE THE EXISTING ENVIRONMENT IN THE IMPACT AREA

Description

The description of the existing environment and the baseline projection (next section) together provide both you and the readers of the EIS a summary overview of economic and demographic conditions in the impact area, and a context for evaluating the effects of the facility. The description of the existing environment utilizes data at the community level if available; otherwise, county-level data are incorporated. Concentrate on economic and demographic conditions in preparing the description of the existing environment.

Data Output/Sources

- A) Employment by Major Sector or 2-Digit SIC.

TABLE 5.

MEANS OF TRANSPORTATION BY DISTANCE TO WORK

(For the United States: 1975. Workers 14 years old and over)

Means of Transportation to work	Total ¹ (thousands)	Percentage distribution by distance to work (miles)								
		Total	Less than 1 mile	1 to 2 miles	3 to 4 miles	5 to 9 miles	10 to 14 miles	15 to 24 miles	25 miles or more	Mean
All workers ¹	70,816	100.0	12.4	16.0	17.2	21.6	13.5	12.3	7.1	8.5
Automobile or truck	61,657	100.0	8.1	16.3	17.9	22.9	14.1	13.1	7.6	9.0
Drive alone	47,188	100.0	8.7	16.9	18.8	23.5	13.8	12.1	6.0	8.3
Carpool	14,470	100.0	6.0	14.4	15.0	20.7	15.0	16.0	12.8	11.4
Public transportation	4,587	100.0	2.8	14.3	21.3	24.1	16.9	13.5	7.0	9.1
Bus or streetcar	2,958	100.0	3.1	18.0	26.1	25.7	15.2	8.7	3.3	7.1
Subway or elevated	1,124	100.0	1.3	5.6	15.8	28.2	26.0	18.7	4.2	10.1
Railroad	367	100.0	-	2.1	0.8	3.9	8.3	39.8	45.7	24.3
Taxicab	118	100.0	18.6	45.8	22.0	11.0	3.4	-	-	2.4
Bicycle	412	100.0	41.4	43.1	10.0	4.2	1.6	-	-	1.4
Motorcycle	285	100.0	11.2	19.3	17.2	19.3	15.8	12.6	4.6	7.5
Walk only	3,645	100.0	91.4	8.3	0.2	0.1	-	-	-	0.1
Other means	210	100.0	27.1	31.4	8.1	19.0	10.0	3.8	-	3.9

¹ Excludes workers with no fixed place of work and workers who worked at home.

Source: U.S. Department of Commerce, Bureau of the Census. "The Journey to Work in the United States: 1975", Current Population Reports, Special Studies, P-23, 899, July 1979.

Major sectors are agriculture, manufacturing, mining, construction, transportation, wholesale trade, retail trade, finance/insurance/real estate, services, and government (see Table 2, Chapter 3). These categories represent Standard Industrial Classification Divisions, and are commonly used for analyzing economic activity.

Source I: State departments of employment security or labor collect monthly data on "insured employment" (i.e., insured through the state's employment insurance system). The data are collected by establishment and published by two-, three-, or four-digit SIC for counties, and occasionally for localities.

Source II: The U.S. Bureau of Labor Statistics publishes these data on an annual basis, for each state and 246 major labor areas within states, most of which are SMSAs. Depending on the importance of the economic sector in the impact area, employment is shown at the SIC Division, 2-digit, or 3-digit level. Historical data are included. There is approximately a two-year publication lag. Data are available in machine-readable form. The data are published in Employment and Earnings: States and Areas.

Source III: A companion source to Source II, also issued by the U.S. Bureau of Labor Statistics (BLS), and available only in machine-readable form, is referred to by BLS as "Total Wage Data." The tape provides total employment by two-digit SIC on an annual basis, with a two-year lag for availability. Extracts for individual counties are available from BLS.

Source IV: Business directories published by states, localities, and private organizations show annual employment data by firm or establishment. These data do not, however, include all firms in the area. This source is not recommended.

- B) • Total labor force
- Percent of labor force unemployed
 - Total employment or number of employees
 - Total unemployment

(Note: These data are generally not available by industry, except where otherwise mentioned in this chapter.)

Source I: The U.S. Bureau of Labor Statistics collects these data for counties on an annual basis, with a two-year lag. Extracts from the data, issued on tape as "Current Population Survey Labor Force Estimates," are available.

Source II: Monthly estimates of total labor force, unemployment, and employment for States, counties and selected areas are available on microfiche from BLS. The series is titled State and County Employment and Unemployment, and the lag is less than a year.

Source III: State departments of labor or divisions of employment security generally issue monthly estimates of unemployment and employment for counties and SMSAs. These data are prepared by those agencies under BLS guidelines and procedures.

Source IV: The U.S. Bureau of the Census' County Business Patterns, contains estimates of the number of employees by county, excluding government employees, railroad employees, self-employed persons, and a few other categories. These estimates are annual, with a two- to three-year lag.

Source V: Revised 1977 OBERS Projections were issued in 1980 by the U.S. Water Resources Council. These projections will include historical data on total employment,* for Bureau of Economic Analysis Areas (BEAs), SMSAs, non-SMSA portions of BEAs, and water resource areas and subareas.

C) Wages or Earnings by Sector.

Source I: BLS "Total Wage" Data contains average weekly wages by 2-digit SIC for counties.

Source II: Employment and Earnings: States and Areas (BLS), contains average weekly earnings and average hourly earnings at the SIC Division, 2-digit and 3-digit level of sectoral disaggregation. For many industries, however, earnings data are not shown.

Source III: The 1977 OBERS Projections, U.S. Water Resources Council, contain historical data on total earnings by sixty industry categories for BEAs, SMSAs, non-SMSA portions of BEAs, and water resource regions and sub-areas.

(D) Income.

This may be expressed in several forms, such as family, personal, household, or per capita income.

Source I: Estimates of total personal and per capita personal income by county are published every April in the Survey of Current Business, which is issued by the U.S. Department of Commerce. There is a two-year lag.

Source II: The "Survey of Buying Power," published every August by Sales & Marketing Magazine, contains estimates of average, median household, and per capita "effective buying income." There is a one-year lag.

Source III: The 1977 OBERS Projections include historical data on total personal income, per capita income, and per

*i.e., not differentiated by economic sector.

capita income relative to the U.S., for BEAs, SMSAs, non-SMSA portions of BEAs, and water resource regions and sub-areas.

(E) Payroll.

Source: Total first quarter and total annual payroll by county is published annually in County Business Patterns. There is a two-year lag. Payroll is not disaggregated by economic sector.

(F) Other Earnings Data

Source I: The 1977 OBERS Projections contain data on earnings per worker and earnings per worker relative to the U.S. for BEAs, SMSAs, non-SMSA portions of BEAs, and water resource regions and subareas.

Source II: State departments of revenue, taxation, finance, or labor may provide total earnings and earnings per worker for counties.

(G) Population.

Source I: Estimates of the population of counties and metropolitan areas within states are available on an annual basis from the U.S. Bureau of the Census, Current Population Reports, "Federal-State Cooperative Program for Population Estimates." Each state is published separately, and there is a one-year lag. Data for selected previous years are shown for comparison.

Source II: The Commercial Atlas and Marketing Guide, published annually by Rand McNally and Company, provides estimated population for counties and communities. The atlas for a given year contains estimates as of January 1st of that year.

Source III: The "Survey of Buying Power," published by Sales and Marketing Magazine, gives annual estimates of population for counties, with a one-year lag.

Source IV: Local jurisdictions and states conduct interim censuses through departments of vital statistics, planning, or economic development. These estimates may also be available from regional planning agencies.

(H) New Housing Units.

Source: The U.S. Bureau of the Census issues, on a monthly basis with a two- to three-month lag, "Housing Units Authorized by Building Permits and Public Contracts." The data are published by state, SMSA, county, and permit-issuing jurisdiction (generally a community). Construction in areas that do not require permits is not covered. At the community and county level, only privately-owned housing units are covered.

(I) Business Establishments.

Source: County Business Patterns, U.S. Bureau of the Census, publishes data on the total number of establishments, by nine employee-size classes, for counties. There is a two-year publication lag.

A good general guide to sources of Federal and State statistical data on population, employment, and income is issued by the U.S. Department of Commerce, Industry and Trade Administration. The book, Measuring Markets: A Guide to the Use of Federal and State Statistical Data, lists, for each program supervised by the State, the

- title of the publication
- geographic and demographic coverage
- frequency of data
- issuing agency, and mailing address

Because state sources are likely to be an excellent source of community and county data, consult this guide to identify these sources. An alternative source is Environmental/Socioeconomic Data Sources, issued October 1976 by the U.S. Department of the Air Force and the U.S. Department of Commerce.

Techniques/Comment

The description of the existing environment should not be exhaustive, but may include elements of the following, according to your judgment as to the relevant issues to emphasize:

- a brief history of the area
- a discussion of the composition of economic activity in the area, with emphasis on the most important economic sectors
- income, wages, and employment data
- population trends, including migration into and out of the area
- a description of major interindustry relationships
- historical housing activity, including a discussion of the geographic distribution of this activity
- special issues, such high unemployment, dependence on one company, or recent high immigration of population.

Emphasize major trends. Incorporate community-level data, if available. Remember that some aspects of the existing environment -- such as infrastructure

and services--are covered in later steps of this chapter, and greater detail is also provided in later steps for housing, employment, population, and other issues. As you reach each of these steps, a more detailed description of the existing environment may be appropriate, and can provide a useful context for evaluating the probable impact of the facility.

4.5 STEP 3: DO A BASELINE PROJECTION OF THE IMPACT AREA WITHOUT THE PROJECT

Description

The baseline projection comprises a forecast of some of the major economic and demographic characteristics covered in the description of the existing environment. This projection assumes the absence of the facility. Subsequent steps of Level C (Steps 4 to 23) measure the incremental effects of the project; i.e., the effects of the project not accounted for by this Step 3 baseline projection without the project.

You may add these incremental effects to the baseline projection without the project in order to produce a baseline projection with the project. However, we have not included a discrete step for that purpose. The conceptual focus of the assessment techniques in this chapter and the principal concern of the EIS is the incremental effects of the project; i.e., the difference between the future conditions without the project (the baseline projection) and the future conditions with the project.

The projection period is the near-term future of ten years. This is consistent with the time frame recommended in the Environmental Impact Assessment Guidelines for Selected New Source Industries.^{*} The accuracy of any projections at the subnational level beyond a ten-year period is highly questionable. Ten years also represents the time period over which the effects of the facility will be analyzed.

Data Output

Essential categories:

- population
- per capita income
- total employment
- total personal income
- earnings or employment by sector.

Other categories:

- total labor force
- new housing starts.

^{*}U.S. Environmental Protection Agency, Washington, D.C., October, 1975.

Source

I: The first five items are available from an economic projection effort entitled OBERS, previously cited. In 1972, the Water Resources Council published projections of economic activity for the nation and for a number of regional groupings:

- states
- SMSAs
- Bureau of Economic Analysis (BEA) areas
- water resources regions and subareas
- non-SMSA portions of the BEA areas
- non-SMSA portions of water resources subareas.

Included were projections of population, personal income, employment, and earnings of persons by industry, for 1980, 1985, 1990, 2000, and 2020.* Revised OBERS projections were issued in 1974 and again in 1980. The 1980 version revises the regional classifications and expands the number of sectors to approximately 60 (see Appendix I.F.).

- II: Local, county, and regional planning organizations prepare projections of population change, total employment or employment by industry, housing activity, and other economic and demographic components. As an example, these projections may be included in a 208 Plan or State Implementation Plan covering all or part of the impact area.
- III: Local economic development agencies or chambers of commerce may project economic activity for their "service" area, or be aware of relevant projections.
- IV: State agencies -- such as departments of commerce, public service commissions, or economic development commissions--project gross economic and demographic activity by county.
- V: Departments of economics or political science at local universities issue special or continuing studies of economic or demographic activity at the state or county level.

*There were 37 OBERS economic sectors in 1972.

Note to EPA regional office users of this manual

The cost-effectiveness guidelines for the wastewater treatment facility construction grants program includes procedures for establishing state and sub-state population forecasts. Consistent forecasts must, according to Agency policy, be used for both air and water quality planning. In practice, the population forecasts approved by the Regional Administrators have been the OBERS (Source I) projections. However, it is possible that another set of population forecasts has been approved in your region; in accordance with cost-effectiveness guidelines, you should use the forecasts approved by the Regional Administrator to assess secondary impacts.

Technique

You should rely most heavily on the OBERS projection for the region most closely approximating the impact area. You should also pay particular attention to any 208 or SIP plans for the impact area, as they provide projections based on local input. The advantage of local or regional plan documents is that they are more likely to incorporate projections at the county or community level.

Review the assumptions underlying the projections. For example, a projected rate of unemployment of 2.5% over the ten-year period may seriously flaw an otherwise apparently useful study, if you know, from the description of the existing environment, that current unemployment in the area is 11% and shows no signs of abating. Similarly, review the methodological basis for the projection. A simple extrapolation of historical data is less desirable than an analysis which probes fundamental shifts in the economic base of the community, changes in migration patterns, or similar determinants of future activity.

Prepare a summary baseline projection from the available studies. Cover at least the seven categories listed previously as outputs from this step. Range estimates are acceptable if several well-founded projections are available. Prepare the projection for ten years hence.

4.6 STEP 4: ESTIMATE DIRECT EMPLOYMENT

Description

This step estimates the direct employment (E*) requirements of the project -- broken down into construction and operating workforce -- for the first ten years of the project, beginning with the first year of construction.

Data Output

See description above and Table 1, Chapter 3, Section 3.4.

Data Source

- A) the permit applicant
- B) if the applicant refuses, contact the appropriate local economic development agency or chamber of commerce. These parties are sufficiently familiar with the facility to accurately estimate direct employment.

Technique

Follow Step 2 of Level B--See Section 3.4 of Chapter 3.

4.7 STEP 5: CALCULATE NON-LOCAL EMPLOYMENT

Description

From the previous step you know that the new source is estimated to create E^* employees each year. The local labor force may supply some of this employment (E_{local}). Estimate the local component, and then calculate the net direct employment increment that must be met by new workers moving into the impact area. Estimate this local component for two years within the ten-year projection period:

- 1) the year during the construction phase of maximum employment. This maximum employment period may include some operations workers;
- 2) the year during the operations phase representing the stable operating workforce. Typically, this will be a year after construction is completed.

As discussed in Chapter 3, Section 3.5, Step 3, there is the possibility that the year of maximum total direct employment may be a year other than those in which either maximum construction or stable operating employment occurs. In such a case, calculate the local component also

- 3) for the year of maximum total direct employment (E_k). This year will include both construction and operations workers.

Do the analysis in Steps 6, 7, 8, and 10 for the year of peak construction employment, stable operating employment, and (if different) peak total employment.

Data Output

- A) the portion of the direct employment requirement (E^*) supplied from the local labor force (E_{local}), for the year of maximum project employment during the construction phase, for the year representing the stable operating workforce, and (if different) for the years representing maximum total employment.
- B) the net direct employment (E , or $E^* - E_{\text{local}}$) that must be met by workers moving into the impact area. Again, make this estimate for the two (or three) years discussed in A.

Data Source

- A) the permit applicant
- B) local economic development officials or the Chamber of Commerce
- C) Bureau of Labor Statistics, Current Population Survey Labor Force Estimates

Technique

Follow Step 3 of Level B - see Section 3.5.

4.8 STEP 6: CALCULATE INDIRECT EMPLOYMENT

Description

Indirect employment represents employment in other economic sectors attributable to the facility but not directly associated with it. It includes employment in firms which supply inputs or receive outputs from the facility, and which locate in proximity to the facility (i.e., in the impact area), as well as employment in commercial or service sector activity necessary to sustain the population increase arising from both the employment at the facility and at supplier/buyer firms.

Data Output

- A) the total direct and indirect employment (E_t) attributable to the facility, for the two (or three) years of analysis within the ten-year period.*

Data Input/Source

- A) the net direct employment (E) attributable to the facility.

Source: Step 5

- B) employment by major economic sector, except agriculture, in the current year.

Source: See Step 2, "Describe the Existing Environment" -- there are several sources. See also Figure 5, Chapter 3.

- C) employment by major economic sector for that year which is ten years after construction of the facility has begun.

Source: U.S. Water Resources Council, 1977 OBERS Projections

- D) Population in the current year.

Source: U.S. Bureau of the Census, Current Population Reports, Series P-26.

- E) Population for that year which is ten years after construction of the facility has begun.

Source: U.S. Water Resources Council, op. cit.

- F) Employment in agriculture for the current year.

*i.e., the years of 1) maximum construction employment, 2) operations employment, and 3) maximum total direct employment.

Source: U.S. Bureau of the Census, the most recent Census of Agriculture. Data may have to be interpolated, if the Census is not current.

- G) Employment in agriculture for that year which is ten years after construction of the facility has begun.

Source: Extrapolate U.S. Census of Agriculture data.

Technique

The technique for calculating the indirect employment multiplier for the current year is discussed in Section 3.6, and an example is given in Figure 5, Chapter 3. Because the data are more geographically disaggregated at Level C, a more accurate multiplier is calculated at Level C than at Level B.

Calculating a multiplier for the year ten years after beginning of construction allows you to discern any significant projected shifts in economic activity. If there is a substantial change in this multiplier, the current and future year multiplier, applied to the estimates of net direct employment effectively define the range of indirect employment impact.

4.9 STEP 7: CALCULATE DIRECT AND INDIRECT POPULATION EFFECTS

Description

This represents the population attributable to both direct and indirect employment. This population includes the workers, and the workers' families.

Data Output

- A) total maximum direct and indirect population attributable to the facility for the two (or three) years of analysis within the ten-year period.*

Data Input/Source

- A) total direct and indirect employment (E_T) attributable to the facility in the two (or three) years.

Source: Step 6

Technique

The technique for calculating total maximum direct and indirect population (P_T) is discussed in Section 3.7, and is illustrated in Figure 5, Chapter 3.

4.10 STEP 8: ESTIMATE THE NUMBER OF NEW HOUSEHOLDS

Description

An estimate of the number of households implied by the total maximum direct and indirect population is necessary in order to calculate the number of housing units necessary to accommodate this population.

- *i.e., the years of 1) maximum construction employment, 2) stable operations employment, and 3) maximum total direct employment.

Data Output

- A) Number of households for the two (or three) years of analysis within the ten-year period.*

Data Input/Source

- A) Average household size

Source I: US Bureau of the Census, Statistical Abstract of the United States, 1978.

Source II: You may calculate an average household size for the State containing the impact area by obtaining number of households and population from a state department of commerce or analogous agency. Divide population by number of households.

- B) Total direct and indirect population (P_T) attributable to the facility.

Source: Step 7.

Technique

The technique is discussed in Section 3.8, Level B. Either use a default value of 2.85 to 2.95, or use one of the two sources for average household size listed above.

4.11 STEP 9: REVIEW THE EXISTING HOUSING MARKET

Description

There may be an adequate amount of housing in the impact area to satisfy the needs of the incoming population. The purpose of this step is to estimate the composition of current housing and the number of vacant units.

Data Output

- A) Number of vacant housing units available in the current year.

Data Input/Source

- A) Composition of housing by single-family, multi-family, and mobile home.

Source: U.S. Bureau of the Census, General Housing Characteristics gives housing by community. This census is published every ten years. The latest housing census was in 1980. There is a three-year publication lag.

*i.e., the years of 1) maximum construction employment, 2) stable operations employment, and 3) maximum total direct employment.

B) Number of vacant year-round units at the last census.

Source: U.S. Bureau of the Census, op.cit.

C) Current vacancy rate, rental and for sale units.

Source: Realtors identified through the National Roster of Realtors.

D) Current composition of housing stock. This can be used to update the Census information. Not all communities, however, keep good records on housing stock.

Source: Local assessor or building inspector. Either of these two sources can provide information on both building permits and demolitions. These data can be used to adjust the Census data for number of housing units. Local utilities are also a possible source of updated building stock data.

E) Future composition and/or quantity of housing.

Source: The baseline projection for the impact area.

There are several other possible sources for all five of the categories listed above:

- particularly for a large project with substantial employment, the site selection study may contain a detailed analysis of the current and future housing market, with an estimate of vacant available units.
- 208 and SIP plans
- local or regional planning agencies.

Techniques

The technique for estimating the availability of vacant units is discussed in Step 7, Level B, Section 3.9. You should work with community-level data, although county-level data are an acceptable substitute.

4.12 STEP 10: ESTIMATE THE NUMBER OF NEW HOUSING UNITS REQUIRED

Description

Using the data from the previous two steps, this step estimates the shortfall of housing in the impact area and, therefore, the number of new housing units that must be constructed. The available current vacancies are compared with the number of households requiring housing for both the year of stable

operations, the year of maximum employment during the construction phase, and (if different), the year of maximum total direct employment. This comparison is particularly important if the facility has a large construction workforce, and a short peak employment period.

Data Output

- A) Total number of new housing units required to meet the requirements of the direct and indirect population attributable to the new source.

Data Input

- A) Number of households represented by the direct and indirect population.

Source: Step 8.

- B) Number of vacant units, current year.

Source: Step 9.

Technique

The technique is discussed in Step 8, Level B, Section 3.10. Some comments about the procedure:

- 1) You are interested primarily in identifying the incremental effects of the facility on the local housing market. It is desirable to work with the current-year estimate of housing availability, rather than an estimate or projection of availability in future years. This allows you to estimate the expansion of the current housing stock that will be necessary to handle the new households. If the comparison of new households to the number of current vacant units indicates a housing deficiency, it does not matter that there may be plans to construct new housing; rather, the salient fact is that the housing does not currently exist and its construction cannot be assumed. A shortage of available housing is an indication of potential pressures on infrastructure and the service sector, as well as potential physical impacts.
- 2) However, you should review the baseline or other projections of housing growth and economic activity in the impact area, to identify recent growth patterns in the housing sector, and probable expansion of this sector in future years. A projected expansion of the housing base greater than or equal to the number of units required by the incoming population should be considered in evaluating the effects of the facility. In particular, you should consider the timing of this expansion relative to the timing of the employment and population influx attributable to the facility. We emphasize again that these new units cannot be taken as a given, i.e., there is no guarantee that they will ever be constructed.

Similarly, if your review of the baseline projection indicates that the area has been experiencing a long-term decline in population and economic activity, the number of vacant units available may increase in future years.

as individuals leave the area. This trend may alleviate any potential housing shortage due to the facility. You must recognize that this trend may not continue, and that a major reason for the reversal of this trend may be the siting of the facility in the area, especially if it is a large employer.

- 3) The technique discussed in Section 3.10 assumes that existing housing is filled before any new housing is constructed. Our review of the literature has found no support for the notion of 'structural vacancy', i.e., representing substandard housing that will not be filled even in cases of future housing shortages. You should assume that, in periods of strong demand for housing, all available units will be taken.

It is possible, however, that this assumption overstates the true number of available units in the current market and understates the number of new units that will be required. In particular, if the population influx associated with a project is low enough and slow enough, the existing vacancy rate may be maintained throughout the life of the project, as new housing units are completed. Therefore, the vacancy rate will never reach zero. The level of vacancy maintained during the life of the project depends upon:

- the relative size of the construction workforce and operating workforce, e.g., a large construction workforce for a short period may put pressure on the housing market and effectively reduce the vacancy rate to zero.
- a town experiencing high growth may be completing many new housing units every year, whereas a relatively rural town with large recent outmigration may have completed virtually no units recently.

Therefore, consider the length of the construction period, the relative sizes of construction and operating staff, and the economy of the town in determining the effect on the existing vacancy rate. If you feel that the employment increase will be gradual, do not use a zero vacancy rate in calculating the number of new units required, but rather use a higher vacancy rate assumption. (See Figure 9). This will effectively increase the number of units required, or reduce the surplus of housing units. The higher vacancy rate should approximate the historical figure for the impact area.

4.13 STEP 11: ALLOCATE NEW HOUSING UNITS AMONG COMMUNITIES

Description

If there is insufficient existing housing to accommodate the incoming direct and indirect population, new housing will be constructed. The spatial allocation of these units assumes that construction of these units will take place first in the host and contiguous communities, and then in communities more distant in the commutershed.

EXAMPLE OF DIFFERENT VACANCY RATE ASSUMPTIONS

(Step 10)

Example: Arlington, New York, an unincorporated community of 11,200 people, currently has 3,583 year-round housing units, of which 140, or 3.9% are vacant. The nearby town of Wappingers Falls, with a population of 5,607, has 1,994 year-round housing units, of which 154 are vacant, or 7.7%.

Case 1

A large surface coal-mining operation is locating just outside of Arlington, and will result in about 250 new households moving into this area almost immediately. These households represent the stable operating workforce. Assume that Arlington and Wappingers Falls are isolated, and are therefore the only communities where these households can locate.

If we assume that a zero vacancy rate is a possibility, the 294 vacant units in these two communities will be sufficient to accommodate the 250 new households moving into the area.

Case 2

Assume, on the other hand, that the same coal mining operation will locate in the area. However, in this case, there will be several years of site work, involving a small workforce, followed by a gradual increase in the workforce until a stable level is reached after ten years. Again, this stable workforce will result in 250 new households in the area.

Because the two communities will have a long period to prepare for this influx, it is expected that new housing units will be constructed for most of the households, and that the demand for housing will not result in a zero vacancy rate. The vacancy rate will probably not decline below 3.5% in either community, which is the long-term historical rate for these communities, although current rates are higher.

If the new households take over some of the existing vacancies, and the vacancy rate declines to 3.5%, 15 existing units will be occupied in Arlington and 85 units in Wappingers Falls, for a total of 110. Therefore, 140 new units (250-110) will be required in the two communities over the ten-year period to accommodate the 250 new households.

FIGURE 9

Data Output

- A) Number of new housing units, by type, by community or county in the impact area.

Data Input

- A) Number of total new housing units required by the direct and indirect incoming population.

Source: Step 10.

- B) Land use map for the communities in the impact area.

Source I: local planning board.

II: regional planning agency/ areawide water quality management agency.

III: State department of community affairs

IV: U.S. Geological Survey, quadrangle maps

V: There are areas where no land use maps are available. You may develop them, albeit at some expense by

- having the impact area flown over, and then interpreting the aerial photographs. We recommend that you rely upon a reputable aerial photography service listed in Photogrammetric Engineering
- you may obtain recent aerials at minimal cost from the National Cartographic Information Center, U.S Geological Survey, Reston, Virginia. The Center stocks maps developed by Federal agencies.

A land use map should identify the following uses:

- Residential
 - single-family
 - multi-family
 - mobile homes
- Commercial/Service/Retail
- Manufacturing/Warehouse
- Public Land
 - parks and recreation
 - community facilities
 - schools
 - conservation land

- semi-public uses

- churches
- hospitals
- golf courses
- highways/streets
- agriculture.

You are not likely to obtain a current-year land use map; therefore, some updating will be required. Sources are:

- building permit data to determine type and location of recent development, which should then be mapped.
- utility data should cover new connections to residential and non-residential users.
- real estate agents have an incomplete, but useful, knowledge of new development.
- tax assessor maps frequently indicate land uses and can be compared to the land use map you have already obtained.

The new development should be plotted on an overlay and then compared to the land use map. This aids in identifying the recent pattern of development.

C) Persons per acre in developed areas.

Source: building inspector or tax assessor. At a minimum, obtain the density for recent residential development, i.e., in the last five years. You may compare this to the density of older units, but this is not essential. If these sources are not able to assist you, use the default values in Table 7.

D) Location of recent new residential development in relation to existing development.

Source: discussed previously under land use maps above.

E) Density of development (persons or units per acre) for the previous five years.

Source: building inspector, electric utility.

F) Location and amount of remaining developable land.

Source: land use maps.

TABLE 7
SUGGESTED HOUSING DENSITIES⁽¹⁾

<u>Dwelling Type</u>	<u>Persons Per Acre</u> ⁽²⁾
Single-family detached	15
Single-family semi-detached	21
Single-family attached	31
Two-family detached	21
Two-family semi-detached	31
Multifamily dwellings	33-76
Mobile home or trailer	21

(1) Default values for Step 11 .

(2) Assuming average family size of 2.9 persons.

Source: (1) Koppelman and DeChiara, Urban Planning and Design Criteria, and
 (2) Hamilton, Robert Todd, Alternative Housing Designs that Facilitate Human
 Activity at Four Density Situations, Massachusetts Institute of Technology,
 unpublished thesis.

Technique

Initially, assume that any new housing will locate in the host community and any contiguous communities, considered as a single housing market. This step allocates units among communities, not within communities (Step 12). This allocation relies heavily upon consultation with realtors, assessors, and inspectors, as well as your review of the land use map, and an analysis of the pattern and extent of recent development. Lack of developable land in a community automatically precludes the development of new housing in a community--this lack of developable land also places any sensitive areas in the community at risk. (See Step 20).

Ask local officials (planning board, department of community affairs, realtors, assessor or inspector) to estimate where the new housing units will be built. Compare their responses with the patterns of recent development identified from the land use map. Local officials may suggest a community that has not seen recent development, but which contains available land. In this case the official is essentially forecasting a shift in recent development patterns.

Once you have allocated units (or persons) to specific communities, you should do a quick test to determine whether sufficient developable land is available for these units.

First, assume that all units will be single-family and calculate the acreage required.

Second, assume that all units will be multifamily high-rise, and calculate the acreage required.

We strongly encourage the use of local estimates of housing density (persons per acre). However, the default values we supplied in Table 7 can be used. The estimates of acreage derived by assuming single-family construction, and then multi-family high-rise, effectively defines the range of possible land consumption:

- if the amount of available developable land approximates or exceeds that required assuming all single-family construction, then the available land is sufficient.
- if, however, the amount of developable land approximates that required assuming all multifamily housing, then the available developable land is probably inadequate to accommodate all of the allocated housing units, unless there is good reason to believe that only multi-family housing will be built. Some units must therefore be allocated to other communities.

In boomtown situations, it is assumed that the use of mobile homes will be far higher than the existing typology would indicate. Therefore, in applying the test of available developable land within a community, use the density for mobile homes (Table 7).

The definition of a boomtown in this manual is:

an isolated, small community with an inadequate pool of construction workers and inadequate facilities to accommodate this labor force. Hundreds or thousands of workers must be brought in from elsewhere during the construction period, leading to severe shortages of housing, retail and professional services, and public facilities. A boomtown is a small community (usually less than 10,000 to 15,000 people before any population influx associated with the project begins) that is the central business area located in a county remote from any large population center. Occasionally, a boomtown is a company-sponsored new town. Development of significant permanent housing is unlikely to occur during the boom phase. Projects leading to boomtown effects have a construction workforce many times larger than the operating workforce.

If the host and contiguous community have insufficient available developable land for all of the new housing units that will be required, housing units should be allocated to successively distant communities in the commutershed. If you or the local officials believe that there is a limit to the number of new housing units that will be constructed in a community--other than the constraint imposed by the availability of developable land--then you may override the requirement that all of the developable land in the host and contiguous towns must be consumed before construction may occur elsewhere. In other words, you may allocate new units to communities more distant in the commutershed, even though not all developable land in the host or contiguous communities has been consumed.

An example of the application of Step 11 is given in Figure 10.

4.14 STEP 12: CALCULATE RESIDENTIAL SITE REQUIREMENTS FOR NEW HOUSING UNITS

Description

After units are allocated to communities, calculate the total acreage required by these units, taking into account the typology of these units, i.e. single-family, multi-family, mobile home.

Data Output

- A) Type of new housing units by community: single-family, multi-family, mobile home.
- B) Amount of land (in acres) consumed by each type of housing and total for all housing by community.

Data Input/Source

- A) Number of new housing units allocated to specific communities.

Source: Step 11.

- B) Average housing density for each type of housing in the impact area.
Try to obtain density by community, especially for recent development.
You may use the default values given in Table 7.

Source: tax assessor, building inspector, or default values

- C) Existing typology of housing units by community.

Source: Step 9.

Technique

Assume that the typology of new units constructed will conform to the typology of recently-constructed existing housing. Apportion the new housing to each of these types. Apply the average housing densities to the number of units in each category to estimate new acreage required for residential growth.

As discussed in Step 11, in boomtown situations you should assume that a large number of mobile homes or temporary structures will be used, and that the existing housing typology is not a good guide to the type of housing that will be constructed. Ask local economic development officials, local planners, and the company to estimate the number or percentage of mobile homes that will be used.

You should also consult with the applicant to determine if he or she feels that the typology of recently-constructed existing housing is appropriate for the construction and operations workers of the project. If the applicant recommends an alternative typology and provides adequate justification for it, use this typology (with the average housing densities from Table 7) to carry out this step. An example of the application of Step 12 is given in Figure 10.

4.15 STEP 13: ALLOCATE NEW HOUSING UNITS WITHIN COMMUNITIES

Description

This step is particularly important for the analysis of effects on sensitive areas (Step 20) and noise and pesticides impacts (Steps 18 and 19). Local consultation is highly desirable to carry out this step; however, you can rely upon the information developed in Step 11 to complete this allocation. Recall that in Step 11 you gathered and/or produced updated land use maps which show the location of recent residential development in the impact area. This information can be used for this step to allocate units within communities.

Data Output

- A) Probable location of new housing units within each community in the impact area.

Data Input/Source

- A) Number and type of new housing units, by community.

Source: Step 12.

- B) Location of recent new residential and other development.

Source: Step 11.

(Please note that much of the information given in this example is hypothetical.)

A surface coal mine will be opened near Arlington, New York. The population influx attributable to the project will be gradual -- ten years after the initiation of the project, 250 new households will have moved into the area. Given the gradual nature of this influx, the Step 10 analysis indicates that 140 new housing units will be constructed to accommodate these households. The new units will be located either in Arlington or Wappingers Falls.

The local planning board and several realtors have indicated that virtually all of the new units will probably be constructed in Arlington, rather than Wappingers Falls. Arlington is the larger business center and community of the two, and has experienced more recent development, although neither community has had much growth in recent years.

The most recent land use map for the two communities was done several years ago. However, the assessor's office was able to pinpoint the location of some recent residential and commercial development, virtually all of which was in Arlington.

Of the 140 new units, then, we assume initially that 120 will be located in Arlington, and 20 in Wappingers Falls. Assuming first that all of these units will be single-family detached structures, site requirements are:

Arlington	23 acres
Wappingers Falls	4 acres.

Assuming next that all units will be in small multifamily structures, site requirements are:

Arlington	11 acres
Wappingers Falls	2 acres.

These estimates are based upon an average household size of 2.9, and the default housing densities in Table 5. In particular, we assumed a density of 15 persons per acre for single-family housing, and 33 persons per acre for multi-family dwellings. No local estimates of housing density were available.

Arlington and Wappingers Falls both have several thousand acres of developable land available within their boundaries, so there is sufficient room for the new development.

The current typology of housing in the two communities is:

Figure 10. Example of the Application of Step 11, "Allocate New Housing Units Within Communities," and Step 12, "Calculate Residential Site Requirements"

Figure 10. continued

	<u>Arlington</u>	<u>Wappingers Falls</u>
one-unit structures	1,729 (48.2%)	765 (38.3%)
two or more unit structures	1,756 (49.0%)	1,223 (61.3%)
mobile home or trailer	98 (2.7%)	6 (0.4%)

Recent development has shown a slight trend to more one-unit structures, but the current typology is probably representative of the new housing that will be built to accommodate the new households. The expected development does not qualify as a boomtown, so mobile homes will continue to be an uncommon form of housing in the area.

Table J-1 shows the predicted types of new housing that will be built in the two communities, and the estimated site requirements of this housing. For one-unit structures, we used a density of 15 persons per acre, and for two or more unit structures we used a density of 31 persons per acre.

Recent development in the town of Arlington has been moving linearly along major state highways toward a significant state park containing a wetland. Although there are few residences near the park, it is possible that many of the new units will be constructed near this area. Local realtors and the assessor indicate that much of the development will occur near the park, and this is verified by the pattern of recent development. The sensitive area analysis in Step 20 should consider the potential effects of the new housing on the park and wetland.

Table 8

TYPE OF NEW UNITS AND SITE REQUIREMENTS⁽¹⁾

<u>Arlington</u>	<u>Number of Units</u>	<u>Acres Required</u>
One-unit	58	11
Two or more units	59	6
Mobile home	3	0.5
Total	<u>120</u>	<u>17.5</u>
 <u>Wappingers Falls</u>		
One-unit	8	1.5
Two or more units	12	1
Mobile home	0	0
Total	<u>20</u>	<u>2.5</u>

(1) This table is part of the Figure 10 example application of Steps 11 and 12.

C) Updated land use map--this land use map will include an overlay showing the data in B) above. The overlays to the land use map should also include and highlight

- 1) areas unlikely to experience future development, such as
 - fully-developed areas
 - privately-owned forests or other resource areas
 - publicly-owned lands
- 2) features that inhibit development, such as
 - steep slopes
 - soil conditions unsuitable for construction
 - land adjoining sites such as airports, industrial areas, disposal sites, mines, or quarries
- 3) areas with legal or institutional protection such as those listed under Step 20 of this chapter. These are areas which should be protected or enhanced.

Source: Step 11, and the sources listed under Step 20.

Technique

Consult with local planners, realtors, the building inspector, the tax assessor, and other city officials. Indicate to these parties that you expect 'X' number of housing units will be developed in the community, requiring 'Y' number of acres. Ask them to predict, on the land use map, the probable specific location of these units.

Given that these predictions of the location of new housing involve uncertainty, you should attempt to reduce the burden on local officials of predicting specific spatial location patterns. Use an overlay or coloring system that reflects the likelihood of development. You should use at least three colors or identifiers to show areas which these officials feel

- are very likely to be developed
- have moderate likelihood of being developed
- are not likely to be developed.

Compare these predictions with your information concerning recent development patterns, and the location of available developable land, and modify their estimates, if appropriate. Transfer the information on the probable location of housing units to a single overlay, and include this overlay in the environmental impact statement.

In consulting with local officials, you may encounter some significant discrepancies in the predicted location of new housing units. If this occurs, compile a set of overlays which show the different predicted locations. Consult again with the same local officials, and ask them if they wish to revise their predictions, based on the estimates supplied by others. This exercise should lead to changes in some original predictions, and the development of reasonably congruent estimates.

4.16 STEP 14: ESTIMATE NEW RESIDENTIAL INFRASTRUCTURE DEMAND

Description

The introduction of new population and new housing units into a community may make significant demands upon:

- water supply
- health care
- highways and local roads
- hospitals
- wastewater treatment
- recreation
- libraries
- police and fire protection
- solid waste disposal capacity.

If existing infrastructure is inadequate, there may also be serious community fiscal impacts. Therefore, you may carry out an optional fiscal analysis.

Data Output

- A) Additional infrastructure and personnel required to service the incoming population, particularly that element of the population housed in new units.
- B) Analysis of community revenues and expenditures. We recommend that this analysis be undertaken only for those communities for which the predicted additional infrastructure requirements are significant relative to existing infrastructure.

Data Input

- A) Incoming population, by community, housed in new residential units.

Source: Use the Step 11 estimate of new units within communities, multiplied by average household size.

- B) Current level of infrastructure by community. Depending upon the infrastructure category, the measures of infrastructure capacity are expressed in terms of personnel, number of facilities, size of facilities, etc. The indicators for each category are given in Appendix II, A, Infrastructure Standards.

Source: local agency responsible for the provision of the service or infrastructure. Other sources include a department of community affairs, a local or regional planning agency, or an economic development agency.

C) Number of new housing units, by community,

Source: Step 11.

D) Standards or multipliers for public service or infrastructure.

Source: Appendix II.A provides standards based on national averages. We recommend that you develop a corresponding set of state standards by consulting the state agency, such as the Board of Health, or Department of Education, responsible for regulating or overseeing the particular public service or infrastructure activity. Similarly, local agencies consulted for B) above may have more stringent standards.

E) Standard facility cost estimates.

Source: F.W. Dodge, Construction Cost Manual or Dodge Digest of Building Costs and Specifications.

F) Analysis of current revenues and expenditures.

Source: annual audit report to the Board of Commissioners, City Council, etc.

G) (Optional) Assessed valuation of the facility (projected), current assessed valuation rates by type of housing unit, and current assessed valuation per capita.

Source: local tax assessor.

Technique (See Figure 11 for two examples of this technique).

National-average public service multipliers are given in Appendix II.A. Apply these multipliers to the estimate of the population in new housing units, or to the estimate of new units, in order to project the marginal infrastructure requirements associated with the new activity. Compare these requirements with reserve capacity at existing facilities. An effective way to evaluate the availability of gas, electric power, and telephone services is to present the local utilities with projections of the number and probable location of new units.

Although there may be plans to expand existing infrastructure, do not assume that this infrastructure will be available, unless construction is underway. This assumption provides the most conservative estimate of the demands that the facility will make on the local community.

For each category of infrastructure for which a deficiency is estimated, after allowing for currently available reserve, ask local officials if there are plans to expand this infrastructure. Do not, however, assume that these facilities will be constructed. The most responsible position for you to take in regard to facility expansion is to point out the existence of current deficiencies, and then discuss any local plans to meet these deficiencies. The

ESTIMATING NEW RESIDENTIAL INFRASTRUCTURE DEMANDS

(Step 14)

The case is the same as Figure 9, a surface coal mining plant locating near Arlington, New York. Assume that Case 1 applies, i.e., that 250 households will move into the area almost immediately.

Example 1 - Solid Waste:

Arlington and Wappingers Falls share a landfill, which serves a population of 16,800. The 250 households moving to the area will each generate about 9.2 pounds of solid waste per day, assuming

first adult in household	6.5 pounds
succeeding adults	2.5 pounds
children	1.5 pounds.

The 2,300 pounds per day additional solid waste represents about a 4 percent increase over the 54,000 pounds currently generated. There is no municipal collection system -- individuals are responsible for hauling their own waste to the landfill.

The currently projected life of the landfill is 10 years. This projection assumes no population growth in the area, and in fact, a slight decline is a possibility. The additional 23,000 pounds of waste over the ten-year period will reduce the life of the landfill by less than half a year.

Example 2 - Electric Power:

Central Hudson Gas and Electric serves the two communities. Because the new households will occupy existing vacant units which already have hookups, there is no need to provide new distribution infrastructure. The recent growth in electric demand in the utility's service areas has been far below projections; therefore, the company has sufficient generating capacity to accommodate 250 new households.

FIGURE 11

salient fact, however, is that the deficiency currently exists, and that expansion of deficient facilities cannot be assumed.

(Optional Fiscal Analysis)

Estimate future capital expenditures to overcome infrastructure deficiencies by applying standard facility cost multipliers from F.W. Dodge's Construction Cost Manual. The use of this manual is discussed in Appendix I.B. Compare the resulting capital costs to the bonding limit for the relevant government subunit, taking into account the fact that some governments have special authorities, such as sewer authorities, for certain public services, and that these authorities have their own bonding limit.

Add the additional debt required to finance these facilities to the existing debt level for the community, and compare the total with existing debt levels.

Compute debt financing or carrying costs. Refer to a standard amortization table -- the information needed to use this table is

- the number of years over which the debt is financed
- the relevant nominal interest rate.

Add these carrying costs as expenditures to the current account.

Estimate the revenues from the facility based on the assessed valuation of the facility and the appropriate valuation rate for the type of facility. Note that many facilities are allowed to make payments in lieu of taxes. Consult the tax assessor.

Apply assessed valuation per type of dwelling unit to the new units to estimate the revenue from this tax source. Note that assessed valuation per capita may show an increase or decrease depending on the contribution of the facility. An increase is likely if estimated revenues from the facility and the new housing are not adequate to meet expenditures for expansion of infrastructure.

4.17 STEP 15: ESTIMATE SITE REQUIREMENTS FOR SERVICE SECTOR DEVELOPMENT

Description

If the facility has direct and indirect employment and population effects (Steps 6 and 7), there will be service sector development attributable to the facility. The physical impacts of service sector expansion are generally minor. Vehicular traffic generated by trips to service sites are subsumed under Step 16. Service employment is subsumed under indirect employment in Step 6.

Data Output

- A) Location of new service sector activity.
- B) Estimated number of acres required by this new activity.

Data Input

A) Current location of service sector activity.

Source: updated land use map, Step 11.

B) Location of new housing, by community.

Source: Step 13.

C) Current population of community.

Source: Step 2.

D) Amount of developable land, by community.

Source: updated land use map, Step 11.

E) Amount of land currently consumed by residential and service sector uses.

Source: updated land use map, Step 11.

F) Location of recent service sector development.

Source: discussed under Step 11. Consult utility data, building permit data, and the tax assessor.

G) Site requirements for new housing.

Source: Step 13.

Technique

Calculate a simple ratio of service sector acreage to residential acreage. Apply this to the estimated site requirements for new housing to derive acreage for new service sector activity. Compare this to the available developable land remaining after the construction of the new residential units. If developable land is not available, then service sector expansion in the community, in the absence of zoning changes, is precluded. If there is sufficient developable land, you should consult with local zoning and planning boards, and the local officials listed above, to allocate this service growth. In doing this allocation, consider carefully the pattern of recent service sector development and the location of new housing units. Consider also that service sector expansion need not take place in the same community as the new housing, especially if another community is contiguous to the site of this housing.

4.18 STEP 16: ASSESS AIR POLLUTION IMPACTS

Description

The secondary air quality impacts of a new source industry are defined as the additional pollutant emissions that are related to residential growth needed to accommodate the incoming population. This step will quantify the additional air pollutant emissions from: (1) motor vehicle trips related to the new housing, (2) on-site fuel combustion for heating and cooling of the new housing, and (3) off-site fuel combustion for generating the additional electricity required by the new housing. The motor vehicle emissions that are calculated correspond to trips for all purposes in the commutershed, including trips to new commercial support facilities. However, on-site emissions for heating and cooling of such commercial development is ignored. On-site fuel combustion emissions from new housing as well as motor vehicle emissions will generally be released as an area source, i.e., at a low density over a large area. By contrast, the off-site fuel combustion for generating new electricity can be assumed to occur at one or more of the existing generating stations in the region.

Emissions are estimated in this step for six different pollutants related to the National Ambient Air Quality Standards: sulfur oxides (SO_x), total suspended particulates (TSP), nitrogen oxides (NO_x), non-methane hydrocarbons (NMHC), carbon monoxide (CO), and lead (Pb). Emissions are not estimated for ozone (O_3) since this pollutant is formed in the atmosphere through a complex series of photochemical reactions. Control strategies for O_3 generally focus on emission rates for NMHC and NO_x . In urban areas, motor vehicles are the principal source of NMHC emissions, which are also referred to as volatile organic compounds (VOC). Fuel combustion normally produces small amounts of NMHC. Due to the fact that existing hydrocarbon emission factors for fuel combustion sources do not distinguish the methane portion, emission estimates for these sources are on the basis of total hydrocarbons (HC) only.

The air pollutant emissions estimated by this analysis can be translated into ambient air quality levels using available computer dispersion models. However, due to the extensive data input requirements of such models, no attempt has been made to incorporate them into this analysis. A recommended introduction to air quality modeling is EPA's Guideline publication.*

An example of the application of this step is given in Figure 14.

Data Output:

- A) Total additional air pollutant emissions from motor vehicle trips associated with new housing, in the year of peak housing requirements.

Units = Additional tons/year of NMHC, CO, NO_x , TSP, Pb, SO_x

- B) Total additional air pollutant emissions from new housing fuel combustion, in the year of peak housing requirements.

Units: Additional tons/year of HC, CO, NO_x , TSP, SO_x **

*EPA Office of Air Quality Planning and Standards, Guideline on Air Quality Models, EPA-450/2-78-027, Research Triangle Park, NC, 1978.

**Since Pb emissions from all types of residential fuel combustion are negligible, Pb is not included here.

- C) Total air pollutant emissions from fuel combustion for additional electrical generation, in the year of peak housing requirements.

Units: Additional tons/year of HC, CO, NO_x, TSP, Pb, SO_x

Data Input:

- A) Total number of additional new housing units, by type, needed in the year of peak housing requirements to accommodate increased population from the construction and operation of the new source industry. Housing units should be classified as single family (H_s) or multiple family (H_m). The year of peak housing requirements is determined by examining the time period comprising the first ten years of construction and operation.

Source: Previous analysis by reviewer--Step 12.

- B) Average trip lengths for work trips (L_w) and other trips (L_o) in miles. L_w can be estimated as the distance (by road) from the centroid of new housing units to the new source industry. L_o can be estimated as the distance (by road) from the centroid of new housing units to the nearest central business district.

Source: Local transportation planning agency.

- C) Residential trip generation rates for trips from single family development to work (T_{sw}) and other destinations (T_{so}), and from multiple family dwellings to work (T_{mw}) and other destinations (T_{mo}). A trip generation rate is defined as the 24-hour estimate of one-way vehicle trips to and from a dwelling unit. Default values, based on nationwide statistics, are T_{sw} = 1.8, T_{so} = 9.0, T_{mw} = 1.0, T_{mo} = 5.0.*

Source: Local transportation planning agency

- D) The fraction of all new housing units using various fuels for space heating:

electricity (SH_e)
gas (SH_g)
oil (SH_o)

for domestic hot water:

electricity (HW_e)
gas (HW_g)
oil (HW_o)

*Guldberg, P. and D'Agostino, R., Growth Effects of Major Land Use Projects, Volume II, EPA-450/3-78-014b, Research Triangle Park, NC, 1978.

for cooling and clothes drying:

electricity (CC_e)
gas (CC_g)

and for central air conditioning:

electricity (AC_e)
gas (AC_g)
oil (AC_o).

A fraction is defined as a number between 0.0 and 1.0. Fractions for a given purpose should sum to 1.0; e.g., $SH_e + SH_g + SH_o = 1.0$. The only exception is central air conditioning which may not be present in all new housing units. In this case, AC_e , AC_g , and AC_o should sum to the fraction of new housing units with central air conditioning.

Source: Local planning board, developers, building inspectors, or real estate agents.

E) The fraction of current electrical generation at power plants in the region produced by various fuels:

coal (EG_c)
oil (EG_o)
gas (EG_g)
nuclear and hydroelectric (EG_n).

For regions where coal is burned, the average percent sulfur (S_c) and ash (A_c) in the coal by weight is required. For regions where oil is burned, the average percent sulfur (S_o) in the oil by weight is needed. For regions where air pollution control equipment is operating at electrical power plants, the average fraction of sulfur oxides (R_s) and particulates (R_p) removed from boiler flue gas should be obtained.

Source: Local utility company, or state air pollution control agency.

Techniques (A sample application of this technique is given in Figure 14.)

(A) Motor Vehicle Emissions

Motor vehicle emissions are estimated using a simple transportation model with composite emission factors contained in EPA technical publications and generated by the EPA

computer model MOBILE1.*

Input to the MOBILE1 calculations were representative nationwide data for the mix of motor vehicles by type, the distribution of the vehicle population by age, and the mix of cold start, hot start, and hot stabilized conditions in the vehicle population. Also input were an annual average ambient temperature of 60°F and an average vehicle speed of 30 mph, chosen to represent a mix of urban, suburban, and highway driving. The model output is shown in Appendix 1-D and can be used to obtain NMHC, CO and NO_x emission factors for a local mix of motor vehicle types, if desired. Changes in the other input parameters, including credits for inspection and maintenance programs, necessitate a re-execution of the MOBILE1 model. Calculation of TSP, Pb, and SO emission factors is outlined in Appendix 1-E. The composite emission factors (EF_{ijk}) suggested for use in this technique are summarized in Tables 9 through 11 by pollutant (i), calendar year (j) and region of the country (k):

- Low altitude region
- California
- High-altitude regions (over 4,000' above MSL).

Total additional air pollutant emissions from motor vehicle trips associated with new housing can be calculated as follows:

$$\begin{aligned}\text{NMHC (tons/year)} &= 1.1 \times 10^{-6} (\text{MILES} \times \text{EF}_{ijk}) \\ \text{CO (tons/year)} &= 1.1 \times 10^{-6} (\text{MILES} \times \text{EF}_{ijk}) \\ \text{NO}_x \text{ (tons/year)} &= 1.1 \times 10^{-6} (\text{MILES} \times \text{EF}_{ijk}) \\ \text{TSP (tons/year)} &= 1.1 \times 10^{-6} (\text{MILES} \times \text{EF}_{ijk}) \\ \text{Pb (tons/year)} &= 1.1 \times 10^{-12} (\text{MILES} \times \text{EF}_{ijk})\end{aligned}$$

*EPA Office of Transportation and Land Use Policy, Mobile Source Emission Factors, EPA-400/9-78-005, Washington, D.C., 1978.

EPA Office of Air, Noise, and Radiation, User's Guide to MOBILE1: Mobile Source Emissions Model, EPA-400/9-78-007, Washington, D.C., 1978. Mobile2, the successor to MOBILE1, has been under development for some time. It will not be available for use until Spring, 1981 at the earliest, at which point it will be distributed through the National Technical Information Service.

EPA Office of Air Quality Planning and Standards, Compilation of Air Pollutant Emission Factors; Publication No. AP-42, Third Edition, including Supplements 1-10, Research Triangle Park, NC, 1980.

Caiazza, R. et. al, User's Manual for the Lead Line Source Model (PBLSQ), Draft EPA Publication, Research Triangle Park, N.C., 1979.

TABLE 9

Composite Motor Vehicle Emission
Rates for Low Altitude Regions

Calendar Year	NMHC	CO	Emission Rate (grams/mile)		PB*	SOX
			NOX	TSP		
1980	4.8	44.3	4.0	0.34	7300	0.23
1981	4.2	40.7	3.8	0.34	6800	0.23
1982	3.7	37.3	3.5	0.33	4700	0.23
1983	3.2	33.7	3.4	0.33	3000	0.23
1984	2.8	30.2	3.2	0.33	2300	0.23
1985	2.4	27.2	3.0	0.33	1600	0.23
1986	2.2	24.5	2.8	0.33	1400	0.23
1987	2.0	22.3	2.7	0.33	1200	0.23
1988	1.8	20.5	2.5	0.33	950	0.23
1989	1.7	19.1	2.4	0.33	350	0.23
1990	1.6	18.1	2.4	0.33	440	0.23
1991	1.6	17.3	2.3	0.33	440	0.23
1992	1.5	16.7	2.3	0.33	440	0.23
1993	1.5	16.2	2.3	0.33	440	0.23
1994	1.4	15.9	2.2	0.33	440	0.23
1995	1.4	15.6	2.2	0.33	420	0.23
1996	1.4	15.6	2.2	0.33	420	0.23
1997	1.4	15.6	2.2	0.33	420	0.23
1998	1.4	15.6	2.2	0.33	420	0.23
1999	1.4	15.6	2.2	0.33	420	0.23

*Units are in micrograms of lead per vehicle mile.

TABLE 10

*Composite Motor Vehicle Emission
Rates for California*

Calendar Year	Emission Rate (grams/mile)					PB*	SOX
	NMHC	CO	NOX	TSP			
1980	4.5	38.1	3.4	0.34	7300		0.23
1981	3.9	35.0	3.2	0.34	6800		0.23
1982	3.4	32.1	3.0	0.33	4700		0.23
1983	2.9	29.3	2.8	0.33	3000		0.23
1984	2.5	26.6	2.7	0.33	2300		0.23
1985	2.2	24.3	2.6	0.33	1600		0.23
1986	2.0	22.5	2.5	0.33	1400		0.23
1987	1.8	21.0	2.4	0.33	1200		0.23
1988	1.7	19.9	2.3	0.33	950		0.23
1989	1.6	19.0	2.2	0.33	850		0.23
1990	1.6	18.3	2.2	0.33	440		0.23
1991	1.5	17.8	2.2	0.33	440		0.23
1992	1.5	17.3	2.1	0.33	440		0.23
1993	1.4	17.0	2.1	0.33	440		0.23
1994	1.4	16.7	2.1	0.33	440		0.23
1995	1.4	16.5	2.1	0.33	420		0.23
1996	1.4	16.5	2.1	0.33	420		0.23
1997	1.4	16.5	2.1	0.33	420		0.23
1998	1.4	16.5	2.1	0.33	420		0.23
1999	1.4	16.5	2.1	0.33	420		0.23

*Units are in micrograms of lead per vehicle mile.

TABLE 11

*Composite Motor Vehicle Emission
Rates for High Altitude Regions*

Calendar Year	Emission Rate (grams/mile)					
	NMHC	CO	NOX	TSP	PB*	SOX
1980	6.3	65.5	3.0	0.34	7300	0.23
1981	5.5	59.0	2.9	0.34	6800	0.23
1982	4.7	53.0	2.7	0.33	4700	0.23
1983	4.1	47.0	2.6	0.33	3000	0.23
1984	3.5	40.9	2.5	0.33	2300	0.23
1985	3.0	35.6	2.4	0.33	1600	0.23
1986	2.6	31.1	2.3	0.33	1400	0.23
1987	2.3	27.4	2.3	0.33	1200	0.23
1988	2.1	24.4	2.2	0.33	950	0.23
1989	1.9	22.0	2.2	0.33	850	0.23
1990	1.8	20.2	2.2	0.33	440	0.23
1991	1.7	18.9	2.2	0.33	440	0.23
1992	1.6	17.9	2.2	0.33	440	0.23
1993	1.5	17.2	2.2	0.33	440	0.23
1994	1.5	16.6	2.2	0.33	420	0.23
1995	1.5	16.2	2.2	0.33	420	0.23
1996	1.5	16.2	2.2	0.33	420	0.23
1997	1.5	16.2	2.2	0.33	420	0.23
1998	1.5	16.2	2.2	0.33	420	0.23
1999	1.5	16.2	2.2	0.33	420	0.23

*Units are in micrograms of lead per vehicle mile.

$$SO_x \text{ (tons/year)} = 1.1 \times 10^{-6} (\text{MILES} \times EF_{ijk})$$

where:

$$\begin{aligned} \text{MILES (trip miles} \\ \text{per year)} &= 365 (L_w (H_s T_{sw} + H_m T_{mw}) \\ &\quad + L_o (H_s T_{so} + H_m T_{mo})) \end{aligned}$$

i = pollutant for which emissions are being calculated

j = year of peak housing requirements

k = region of the country in which the new source industry is to be located

B) New Housing Emissions

On-site residential emissions are estimated with land-use based emissions factors* developed for energy use at single-family and multiple-family dwellings. Data required to use these factors are estimates of heating degree days (HDD) and air conditioner compressor operating hours (ACH) for new homes locating in the region of the new source industry. Values for these two parameters should be read off of Figures 12 and 13. Total additional air pollutant emissions from new housing fuel combustion can be estimated as follows:

$$\begin{aligned} HC \text{ (tons/year)} &= 0.0005 (H_s (2.0 \times 10^{-4} HDD \times SH_g + 2.4 \times 10^{-1} HW_g \\ &\quad + 8.8 \times 10^{-2} CC_g + 1.4 \times 10^{-4} ACH \times AC_g \\ &\quad + 6.6 \times 10^{-4} HDD \times SH_o + 7.5 \times 10^{-1} HW_o) \\ &\quad + H_m (9.7 \times 10^{-5} HDD \times SH_g + 1.9 \times 10^{-1} HW_g \\ &\quad + 9.6 \times 10^{-2} CC_g + 1.3 \times 10^{-4} ACH \times AC_g \\ &\quad + 3.4 \times 10^{-4} HDD \times SH_o + 6.0 \times 10^{-1} HW_o \\ &\quad + 1.3 \times 10^{-4} ACH \times AC_o)) \end{aligned}$$

$$\begin{aligned} CO \text{ (tons/year)} &= 0.0005 (H_s (5.1 \times 10^{-4} HDD \times SH_g + 6.0 \times 10^{-1} HW_g \\ &\quad + 2.2 \times 10^{-1} CC_g + 3.5 \times 10^{-4} ACH \times AC_g \\ &\quad + 1.1 \times 10^{-3} HDD \times SH_o + 1.2 HW_o) \\ &\quad + H_m (2.4 \times 10^{-4} HDD \times SH_g + 4.8 \times 10^{-1} HW_g \end{aligned}$$

*Guldberg, P. and D'Agostino, R., Growth Effects of Major Land Use Projects, Volume II, EPA-450/3-78-014b, Research Triangle Park, NC, 1978. These factors assume average dwelling unit floor areas of 1600 square feet (single family) and 900 square feet (multiple family). In addition, the sulfur content of distillate fuel oil is assumed to be 0.3% by weight.

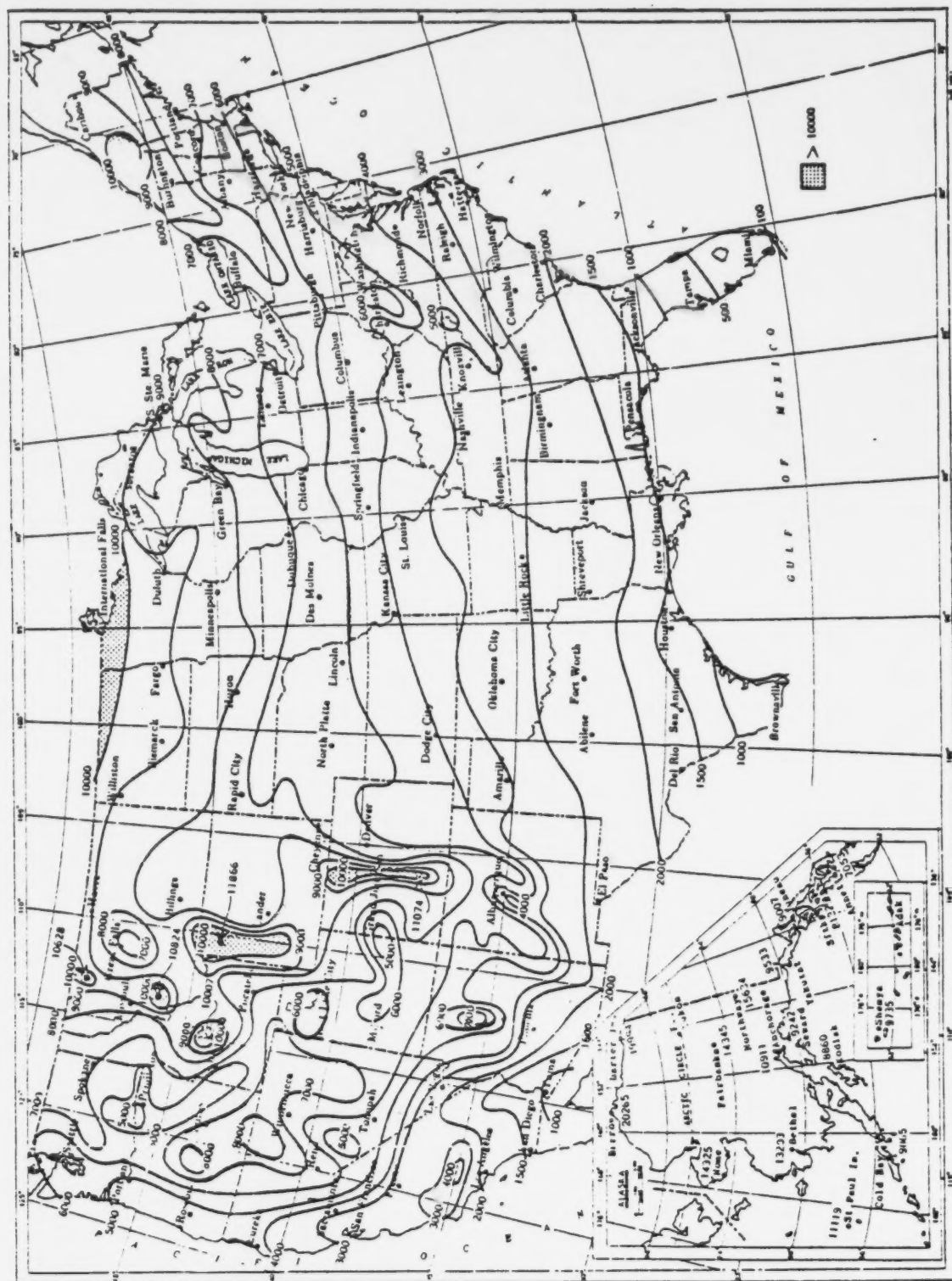


Figure 12. Normal seasonal heating degree days (base 65°F) 1941-1970.

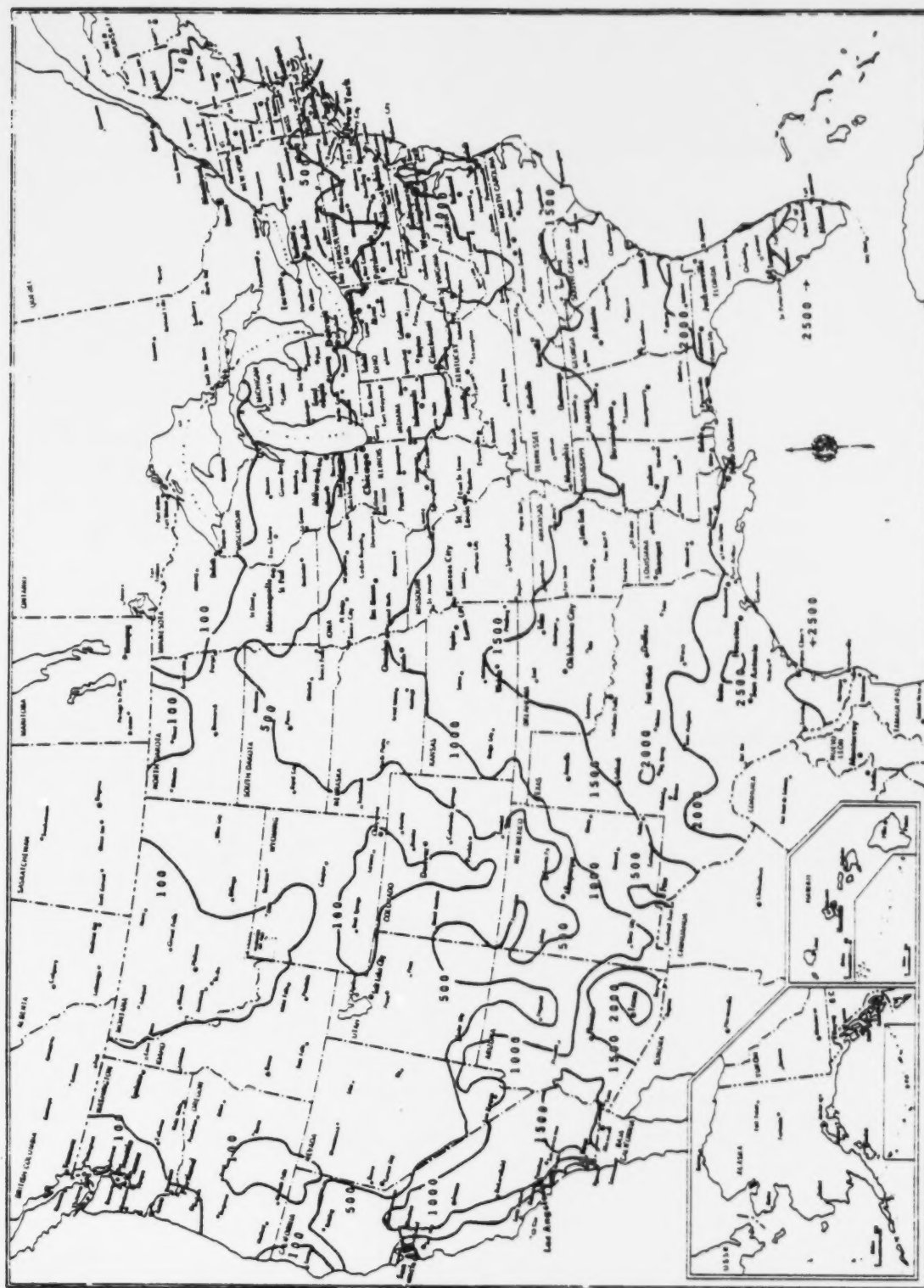


Figure 1.3. Annual air conditioner compressor operating hours for residential structures.

$$\begin{aligned}
&+2.4 \times 10^{-1} \text{CC}_g + 1.2 \times 10^{-4} \text{ACH} \times \text{AC}_g \\
&+5.7 \times 10^{-4} \text{HDD} \times \text{SH}_o + 1.0 \text{HW}_o \\
&+2.2 \times 10^{-4} \text{ACH} \times \text{AC}_o))
\end{aligned}$$

$$\begin{aligned}
\text{NO}_x(\text{tons/year}) = 0.0005 & \left(\text{H}_s (2.6 \times 10^{-3} \text{HDD} \times \text{SH}_g + 3.0 \text{HW}_g \right. \\
&+1.1 \text{CC}_g + 1.8 \times 10^{-3} \text{ACH} \times \text{AC}_g \\
&+2.6 \times 10^{-3} \text{HDD} \times \text{SH}_o + 3.0 \text{HW}_o) \\
&+ \text{H}_m (1.2 \times 10^{-3} \text{HDD} \times \text{SH}_g + 2.4 \text{HW}_g \\
&+1.2 \text{CC}_g + 6.2 \times 10^{-4} \text{ACH} \times \text{AC}_g \\
&+1.4 \times 10^{-3} \text{HDD} \times \text{SH}_o + 2.4 \text{HW}_o \\
&+5.3 \times 10^{-4} \text{ACH} \times \text{AC}_o))
\end{aligned}$$

$$\begin{aligned}
\text{TSP}(\text{tons/year}) = 0.0005 & \left(\text{H}_s (2.6 \times 10^{-4} \text{HDD} \times \text{SH}_g + 3.0 \times 10^{-1} \text{HW}_g \right. \\
&+1.1 \times 10^{-1} \text{CC}_g + 1.8 \times 10^{-4} \text{ACH} \times \text{AC}_g \\
&+2.2 \times 10^{-3} \text{HDD} \times \text{SH}_o + 2.5 \text{HW}_o) \\
&+ \text{H}_m (1.2 \times 10^{-4} \text{HDD} \times \text{SH}_g + 2.4 \times 10^{-1} \text{HW}_g \\
&+1.2 \times 10^{-1} \text{CC}_g + 6.2 \times 10^{-5} \text{ACH} \times \text{AC}_g \\
&+1.1 \times 10^{-3} \text{HDD} \times \text{SH}_o + 2.0 \text{HW}_o \\
&+4.5 \times 10^{-4} \text{ACH} \times \text{AC}_o))
\end{aligned}$$

$$\begin{aligned}
\text{SO}_x(\text{tons/year}) = 0.0005 & \left(\text{H}_s (1.5 \times 10^{-5} \text{HDD} \times \text{SH}_g + 1.8 \times 10^{-2} \text{HW}_g \right. \\
&+6.6 \times 10^{-3} \text{CC}_g + 1.1 \times 10^{-5} \text{ACH} \times \text{AC}_g \\
&+9.6 \times 10^{-3} \text{HDD} \times \text{SH}_o + 11.0 \text{HW}_o) \\
&+ \text{H}_m (7.3 \times 10^{-6} \text{HDD} \times \text{SH}_g + 1.4 \times 10^{-2} \text{HW}_g \\
&+7.2 \times 10^{-3} \text{CC}_g + 3.7 \times 10^{-6} \text{ACH} \times \text{AC}_g \\
&+5.1 \times 10^{-3} \text{HDD} \times \text{SH}_o + 8.7 \text{HW}_o \\
&+6.4 \times 10^{-3} \text{ACH} \times \text{AC}_o))
\end{aligned}$$

C) Power Plant Emissions

Off-site emissions related to additional electrical generation require two calculations. First, the additional electrical load (kwh/year) is estimated with land-use based emission factors*, and second this

*Guldberg, P. and D'Agostino, R., Growth Effects of Major Land Use Projects, Volume II, EPA-450/3-78-014b, Research Triangle Park, NC, 1978.

electrical demand is translated into stationary source emissions using EPA's AP-42 emission factors* and some representative assumptions.** The additional electricity demanded by new housing can be calculated as follows:

$$\begin{aligned} \text{KWH(kwh/year)} = & H_s (3.8 \text{ HDD} \times SH_e + 4.7 \text{ ACH} \times AC_e \\ & + 1.4 \times 10^4 \text{ HW}_e + 3.5 \times 10^3 \text{ CC}_e \\ & + 7.9 \times 10^3) \\ & + H_m (1.3 \text{ HDD} \times SH_e + 1.5 \text{ ACH} \times AC_e \\ & + 1.1 \times 10^4 \text{ HW}_e + 3.8 \times 10^3 \text{ CC}_e \\ & + 4.4 \times 10^3) \end{aligned}$$

Off-site power plant emissions related to generating this additional power can be calculated as follows:

$$\begin{aligned} \text{HC (tons/year)} = & 0.0005 \text{ KWH} (1.2 \times 10^{-4} \text{ EG}_c \\ & + 1.6 \times 10^{-4} \text{ EG}_o \\ & + 1.2 \times 10^{-5} \text{ EG}_g) \end{aligned}$$

$$\begin{aligned} \text{CO (tons/year)} = & 0.0005 \text{ KWH} (4.0 \times 10^{-4} \text{ EG}_c \\ & + 2.4 \times 10^{-4} \text{ EG}_o \\ & + 2.0 \times 10^{-4} \text{ EG}_g) \end{aligned}$$

$$\begin{aligned} \text{NO}_x \text{ (tons/year)} = & 0.0005 \text{ KWH} (2.2 \times 10^{-2} \text{ EG}_c \\ & + 8.3 \times 10^{-3} \text{ EG}_o \\ & + 8.3 \times 10^{-3} \text{ EG}_g) \end{aligned}$$

$$\begin{aligned} \text{TSP(tons/year)} = & 0.0005 \text{ KWH} (1.0 - R_p) (5.23 \times 10^{-3} A_c \times \text{EG}_c \\ & + 6.34 \times 10^{-4} \text{ EG}_o \\ & + 1.19 \times 10^{-4} \text{ EG}_g) \end{aligned}$$

*EPA Office of Air Quality Planning and Standards, Compilation of Air Pollutant Emission Factors, Third Edition, Supplements 1-10, Publication No. AP-42, Research Triangle Park, NC, 1980.

**Overall power plant efficiency is assumed to be 33.3% and 31.6% respectively, for coal and oil/gas-fired plants. A transmission loss of 10% is also assumed.

$$\text{Pb (tons/year)} = 0.0005 \text{ KWH } (5.4 \times 10^{-6} \text{ EG}_c + 3.4 \times 10^{-7} \text{ EG}_o)$$

$$\text{SO}_x \text{ (tons/year)} = 0.0005 \text{ KWH } (1.0 - R_s) (1.5 \times 10^{-2} S_c \times \text{EG}_c + 1.3 \times 10^{-2} S_o \times \text{EG}_o + 7.1 \times 10^{-6} \text{ EG}_g)$$

Suppose a new source industry is planned for the region near Boston, Massachusetts and the total number of additional housing units needed is:

- Single family, $H_s = 200$ units
- Multiple family, $H_m = 300$ units

The year of peak housing requirements is determined to be 1985. Average trip lengths are estimated as:

- Work trips, $L_w = 8$ miles
- Other trips, $L_o = 12$ miles

As the local transportation agency has no data on trip generation rates, the default values are used. The fraction of new housing units using various fuels is projected to be:

- Space heating, $SH_e = 0.10$, $SH_g = 0.20$, $SH_o = 0.70$
- Domestic hot water, $HW_e = 0.50$, $HW_g = 0.20$, $HW_o = 0.30$
- Cooking and clothes drying, $CC_e = 0.80$, $CC_g = 0.20$
- Central air conditioning, $AC_e = 0.20$, $AC_g = 0.05$, $AC_o = 0$

The fraction of current electrical generation produced by various fuels is:

- Coal, $EG_c = 0$
- Oil, $EG_o = 0.70$, $S_o = 1.0\%$
- Gas, $EG_g = 0$
- Nuclear & Hydroelectric, $EG_n = 0.30$

And the average fraction of pollutants removed from flue gas are:

- Sulfur, $R_s = 0$
- Particulates, $R_p = 0.90$

Motor vehicle emissions are estimated for a low altitude region in 1985. The additional trip miles per year are:

$$\begin{aligned} \text{MILES} &= 365 (8.0 (200 \times 1.8 + 300 \times 1.0) \\ &\quad + 12 (200 \times 9.0 + 300 \times 5.0)) \\ &= 1.6 \times 10^7 \text{ miles} \end{aligned}$$

Figure 14. Example of the Application of Step 16, "Assess Air Pollution Impacts"

Figure 14. continued

Total additional motor vehicle air pollutant emissions are:

$$\begin{aligned}
 \text{NMHC} &= 1.1 \times 10^{-6} (1.6 \times 10^7 \times 2.4) = 42 \text{ tons/year} \\
 \text{CO} &= 1.1 \times 10^{-6} (1.6 \times 10^7 \times 27.2) = 480 \text{ tons/year} \\
 \text{NO}_x &= 1.1 \times 10^{-6} (1.6 \times 10^7 \times 3.0) = 53 \text{ tons/year} \\
 \text{TSP} &= 1.1 \times 10^{-6} (1.6 \times 10^7 \times 0.33) = 5.8 \text{ tons/year} \\
 \text{P}_b &= 1.1 \times 10^{-12} (1.6 \times 10^7 \times 1600) = 0.028 \text{ tons/year} \\
 \text{SO}_x &= 1.1 \times 10^{-6} (1.6 \times 10^7 \times 0.23) = 4.0 \text{ tons/year}
 \end{aligned}$$

New housing emissions are based on an annual heating degree day value of HDD = 6000 and an air conditioner operating value of ACH = 400 hours. Total additional air pollutant emissions are:

$$\begin{aligned}
 \text{HC} &= 0.0005 (200(2.0 \times 10^{-4} \times 6000 \times 0.20 + 2.4 \times 10^{-1} \times 0.20 \\
 &\quad + 8.8 \times 10^{-2} \times 0.20 \quad + 1.4 \times 10^{-4} \times 400 \times 0.05 \\
 &\quad + 6.6 \times 10^{-4} \times 6000 \times 0.70 + 7.5 \times 10^{-1} \times 0.30) \\
 &\quad + 300(9.7 \times 10^{-5} \times 6000 \times 0.20 + 1.9 \times 10^{-1} \times 0.20 \\
 &\quad + 9.6 \times 10^{-2} \times 0.20 \quad + 1.3 \times 10^{-4} \times 400 \times 0.05 \\
 &\quad + 3.4 \times 10^{-4} \times 6000 \times 0.70 + 6.0 \times 10^{-1} \times 0.30)) \\
 &= 0.60 \text{ tons/year}
 \end{aligned}$$

$$\begin{aligned}
 \text{CO} &= 0.0005 (200(5.1 \times 10^{-4} \times 6000 \times 0.20 + 6.0 \times 10^{-1} \times 0.20 \\
 &\quad + 2.2 \times 10^{-1} \times 0.20 \quad + 3.5 \times 10^{-4} \times 400 \times 0.05 \\
 &\quad + 1.1 \times 10^{-3} \times 6000 \times 0.70 + 1.2 \times 0.30) \\
 &\quad + 300(2.4 \times 10^{-4} \times 6000 \times 0.20 + 4.8 \times 10^{-1} \times 0.20 \\
 &\quad + 2.4 \times 10^{-1} \times 0.20 \quad + 1.2 \times 10^{-4} \times 400 \times 0.05 \\
 &\quad + 5.7 \times 10^{-4} \times 6000 \times 0.70 + 1.0 \times 0.30)) \\
 &= 1.0 \text{ tons/year}
 \end{aligned}$$

$$\begin{aligned}
 \text{NO}_x &= 0.0005 (200(2.6 \times 10^{-3} \times 6000 \times 0.20 + 3.0 \times 0.20 \\
 &\quad + 1.1 \times 0.20 \quad + 1.8 \times 10^{-3} \times 400 \times 0.05 \\
 &\quad + 2.6 \times 10^{-3} \times 6000 \times 0.70 + 3.0 \times 0.30) \\
 &\quad + 300(1.2 \times 10^{-3} \times 6000 \times 0.20 + 2.4 \times 0.20 \\
 &\quad + 1.2 \times 0.20 \quad + 6.2 \times 10^{-4} \times 400 \times 0.05 \\
 &\quad + 1.4 \times 10^{-3} \times 6000 \times 0.70 + 2.4 \times 0.30)) \\
 &= 2.9 \text{ tons/year}
 \end{aligned}$$

Figure 14. continued

$$\begin{aligned}
 \text{TSP} &= 0.0005 (200(2.6 \times 10^{-4} \times 6000 \times 0.20 + 3.0 \times 10^{-1} \times 0.20 \\
 &\quad + 1.1 \times 10^{-1} \times 0.20 \quad + 1.8 \times 10^{-4} \times 400 \times 0.05 \\
 &\quad + 2.2 \times 10^{-3} \times 6000 \times 0.70 + 2.5 \times 0.30) \\
 &\quad + 300(1.2 \times 10^{-4} \times 6000 \times 0.20 + 2.4 \times 10^{-1} \times 0.20 \\
 &\quad + 1.2 \times 10^{-1} \times 0.20 \quad + 6.2 \times 10^{-5} \times 400 \times 0.05 \\
 &\quad + 1.1 \times 10^{-3} \times 6000 \times 0.70 + 2.0 \times 0.30) \\
 &= 1.9 \text{ tons/year}
 \end{aligned}$$

$$\begin{aligned}
 \text{SO}_x &= 0.0005 (200(1.5 \times 10^{-5} \times 6000 \times 0.20 + 1.8 \times 10^{-2} \times 0.20 \\
 &\quad + 6.6 \times 10^{-3} \times 0.20 \quad + 1.1 \times 10^{-5} \times 400 \times 0.05 \\
 &\quad + 9.6 \times 10^{-3} \times 6000 \times 0.70 + 11.0 \times 0.30) \\
 &\quad + 300(7.3 \times 10^{-6} \times 6000 \times 0.20 + 1.4 \times 10^{-2} \times 0.20 \\
 &\quad + 7.2 \times 10^{-3} \times 0.20 \quad + 3.7 \times 10^{-6} \times 400 \times 0.05 \\
 &\quad + 5.1 \times 10^{-3} \times 6000 \times 0.70 + 8.7 \times 0.30)) \\
 &= 8.0 \text{ tons/year}
 \end{aligned}$$

Power plant emissions related to additional electrical generation are based on the following electrical load:

$$\begin{aligned}
 \text{KWH} &= 200(3.8 \times 6000 \times 0.10 + 4.7 \times 400 \times 0.20 \\
 &\quad + 1.4 \times 10^4 \times 0.50 + 3.5 \times 10^3 \times 0.80 \\
 &\quad + 7.9 \times 10^3) \\
 &\quad + 300(1.3 \times 6000 \times 0.10 + 1.5 \times 400 \times 0.20 \\
 &\quad + 1.1 \times 10^4 \times 0.50 + 3.8 \times 10^3 \times 0.80 \\
 &\quad + 4.4 \times 10^3) \\
 &= 8.2 \times 10^6 \text{ kwh/year}
 \end{aligned}$$

Total additional power plant emissions are:

$$\begin{aligned}
 \text{HC} &= 0.0005 \times 8.2 \times 10^6 (1.6 \times 10^{-4} \times 0.70) = 0.46 \text{ tons/year} \\
 \text{CO} &= 0.0005 \times 8.2 \times 10^6 (2.4 \times 10^{-4} \times 0.70) = 0.69 \text{ tons/year} \\
 \text{NO}_x &= 0.0005 \times 8.2 \times 10^6 (8.3 \times 10^{-3} \times 0.70) = 24 \text{ tons/year} \\
 \text{TSP} &= 0.0005 \times 8.2 \times 10^6 (1.0 - 0.9) (6.34 \times 10^{-4} \times 0.70) = 0.18 \text{ tons/year} \\
 \text{Pb} &= 0.0005 \times 8.2 \times 10^6 (3.4 \times 10^{-7} \times 0.70) = 0.00098 \text{ tons/year} \\
 \text{SO}_x &= 0.0005 \times 8.2 \times 10^6 (1.0 - 0) (1.3 \times 10^{-2} \times 1.0 \times 0.70) = 37 \text{ tons/year}
 \end{aligned}$$

Figure 14. continued

In summary, the total secondary air pollutant emissions (in tons/year) related to the assumed new source industry are:

	NMHC	HC	CO	NO _x	TSP	Pb	SO _x
Motor Vehicle	42	-	480	53	5.8	0.028	4.0
Housing	-	0.60	1.0	2.9	1.9	0	8.0
Power Plant	-	0.46	0.69	24	0.18	0.00098	37
Total	42*	1.1*	482	80	7.9	0.029	49

*NMHC emissions are for mobile sources only. Total HC emissions are for stationary sources only.

4.19 STEP 17: ASSESS IMPACTS FROM STORMWATER RUNOFF

Description

This section is concerned with the stormwater pollution loads that may result from new development associated with the location of a new industry. The discussion is limited to stormwater runoff; the water quality issues associated with increased flows to municipal wastewater treatment plants are not considered here. A discussion of increased wastewater flows to wastewater treatment plants is, however, included as an infrastructure demand in Section 4.16.

New development will typically affect both the quantity and quality of surface runoff. By altering surface runoff patterns, particularly the amount of imperviousness (i.e., streets, sidewalks, parking lots, etc.), development will generally increase the volume of rainfall available to runoff. This becomes a fundamental issue, of course, for designing adequate drainage systems for new development. Also important, however, are the potential downstream short-term flooding effects of the increased runoff. Figure 15 shows typical effects of urbanization on runoff.

The runoff will contain a number of pollutants that have accumulated in the drainage area. Typically, impervious surfaces will accumulate more pollutants than areas that remain undisturbed. Thus, stormwater runoff will carry pollutant loads that will vary according to the amount of imperviousness created by the development. The development itself increases the rate of disposition of pollutants, through mechanisms such as road salting, erosion of pavement, spills, litter, or construction activities. Table 12 illustrates magnitude of changes--both quantity and quality--in an example 470-acre watershed.

Accurately predicting quantity and quality effects for new development can be complicated and time-consuming. In particular, there are a number of data-intensive models that have been developed for predicting stormwater pollutant loads. These are not discussed here because they are beyond the scope of review considered appropriate for this guidebook.* The techniques used in this guidebook are generally appropriate for order of magnitude calculations for small to large watersheds. These techniques are not adequate, for instance, in looking at the effects of a shopping center. There is also no attempt in this section to analyze in-stream effects -- either flooding or water quality. The guidebook user faces a far more complicated task in estimating actual water quality effects. The user should consult the Areawide Assessment Procedures Manual for a discussion of techniques.

An example of the application of this step is given in Figure 17.

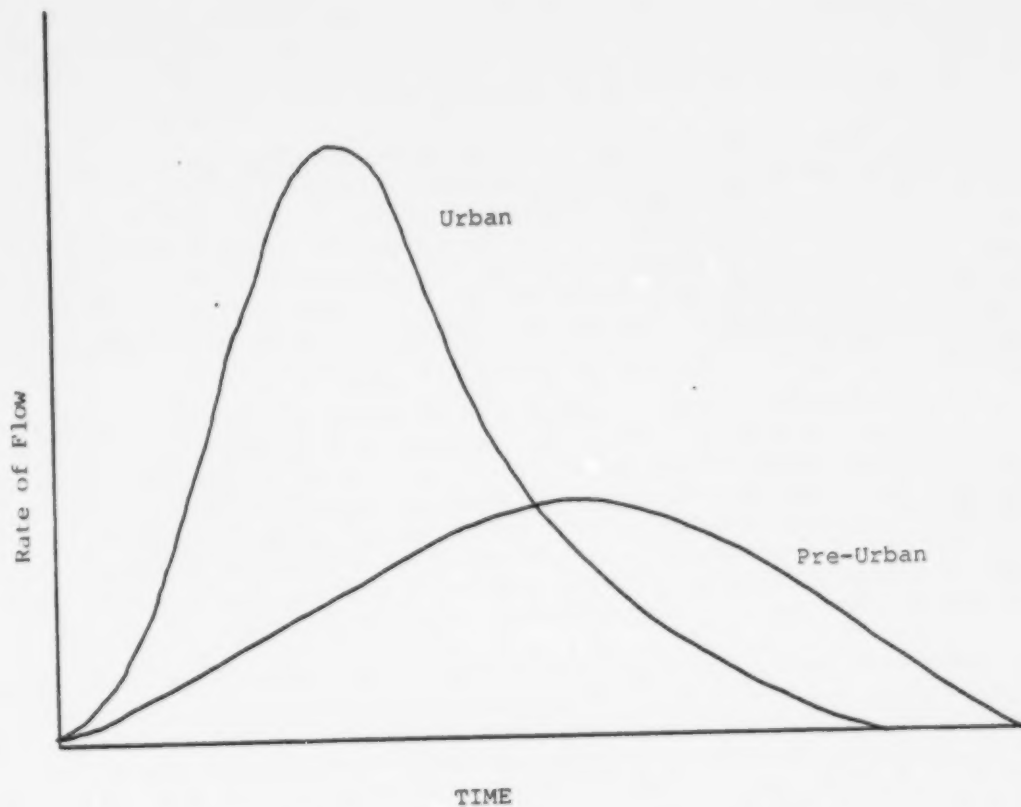
Data Output

- A) Mean runoff flows in a given drainage area where development impacts are being considered.

Units = cubic feet per second (cfs)

- B) Mean runoff pollutant load for a given drainage area for a given storm event where development impacts are being considered.

* For a discussion of more sophisticated and complex techniques, see U.S. EPA Areawide Assessment Procedures Manual, Washington, D.C., EPA 600/9-76-014, July, 1976.



Urbanization Increases Peak Flows and Runoff Volumes

Source: Waller, D.H. "Urban Drainage Problems - An Overview", in Modern Concepts in Urban Drainage, Toronto: Conference Proceedings No. 5, March 28-30, 1977, page 22.

FIGURE 15 EFFECTS OF URBANIZATION ON VOLUME AND RATES OF SURFACE RUNOFF

TABLE 12
EFFECT OF CHANGING LAND USE ON STORM RUNOFF
FROM 470 ACRE SUBAREA

<u>Land Use</u>	<u>Annual Runoff (inches)</u>	<u>Annual BOD Load (pounds)</u>
100% Open	8.34	5.70
67% Single-Family 33% Multi-Family	11.72	23.40

Source: Roesner, Larry, A. "A Storage, Treatment, Overflow, and Runoff Model for Metropolitan Masterplanning" in Short Course Proceedings: Applications of Stormwater Management Models - 1976, Cincinnati: EPA 600/2-77-065, March 1977, p. 316.

Units = lb/day of the following pollutants:

- Biochemical Oxygen Demand (BOD_5)
- Suspended Solids (SS)
- Volatile Solids (VS)
- Total Phosphorus (PO_4)
- Total Nitrogen (N).

Data Input

A) Area in acres of the drainage area being considered

Source: from previous steps.

B) Mean rainfall intensity for an average storm in the drainage area.

Source: local weather station; or 208 planning agency that has done rainfall analysis in connection with its own urban stormwater analysis.

C) Percent impervious area in the drainage area being considered.

Source: from projected land use from previous steps. Percent impervious will vary by the type of land use. The user can use aerial photographs of similar existing development to calculate this or can use the general guide given below:

<u>Land Use Category</u>	<u>Percent Impervious Area</u>
Residential	
Low Density (1-4 units/acre)	20
Medium Density (5-10 units/acre)	40
High Density (11+ units/acre)	60
Commercial	80
Industrial	70
Institutional, Public	30
Open, Undeveloped	0

The percent impervious area for the entire drainage area is calculated by taking a weighted average for the drainage area. For example, assume an area has the following land use characteristics:

Low density residential	40%
Medium density residential	20%
High density residential	0
Commercial	10%
Industrial	0
Institutional/public	5%
Open, Undeveloped	25%
	100%

The overall percent impervious area would be

$$= (.40) \cdot (20) + (.20) \cdot (40) + (0) + (.10) \cdot (80) + (0) + (.5) \cdot (30) + (.25) \cdot (0) = 39\%.$$

D) Runoff coefficient value for the drainage area.

Source: Figure 11 and percent impervious area from C).

E) Land use cover in the drainage area in acres using the following categories: residential, commercial, industrial, other developed areas.

Source: from Step 11, updated land use map.

F) Population density in people per acre.

Source: from information developed in Steps 2 and 3.

Techniques

An example of the application of these techniques is given in Figure 17.

I. Quantity

Mean runoff flow can be estimated by using the rational formula:

$$Q_R = C_v I A \quad (1)$$

where:

Q_R = mean runoff flow (cfs)
 C_v = average runoff coefficient
 I = mean rainfall intensity (in/hr)
 A = drainage area (acres)

As discussed above, C_v as shown in Figure 16 is calculated as a function of average imperviousness of the drainage area.

II. Quality

Mean runoff pollutant loadings are calculated by the following equation:

$$W_R = 5.4 \cdot \bar{c} Q_R \quad (2)$$

where:

W_R = mean runoff loading rate (lbs/day)
 $\bar{c}$ = mean pollutant concentration
 Q_R = mean runoff flow (cfs).
 5.4 = conversion figure (lb/day/cfs-mg/l)

Q_R is obtained from the calculation above using equation (1). In order to obtain $\bar{c}$, the following equation is used:

$$\bar{c} = a(i, j) \cdot p(PD) \quad (3)$$

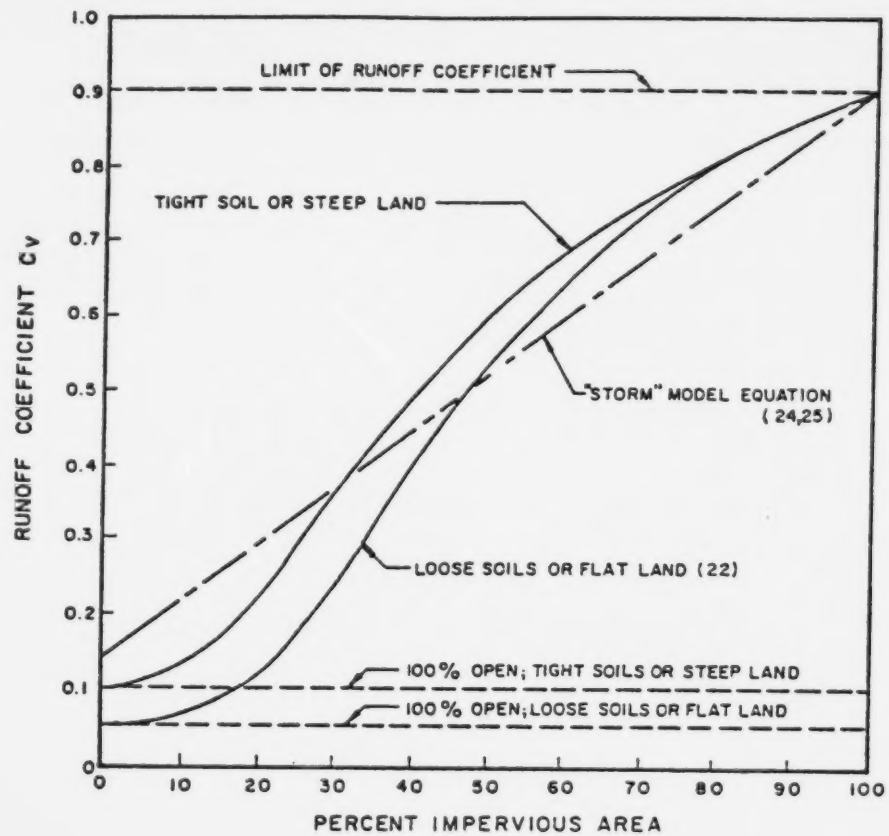


FIGURE 16. RUNOFF COEFFICIENT DETERMINATION FROM LAND COVER INFORMATION.

where:

$\bar{c}$ = concentration of pollutant (j) from land use (i) in (mg/l)

$a(i,j)$ = constant for pollutant (j) and land use (i) in (mg/l)

$p(PD)$ = population function.

The land use categories and pollutants are shown below:

LAND USE AND POLLUTANTS

<u>Land Uses</u>	<u>Pollutants</u>
i=1 Residential	j = 1 BOD ₅ , Total
i=2 Commercial	j = 2 Suspended Solids (SS)
i=3 Industrial	j = 3 Volatile Solids, Total (VS)
i=4 Other Developed Areas	j = 4 Total PO ₄ (as PO ₄)
	j = 5 Total N (as N)

The $a(i,j)$ can be calculated from the following conversion:

$$a(i,j) = (\alpha(i,j) \cdot F) / C_v(i) \quad (4)$$

where:

$F = 4.42$, a constant (mg/l)/(lb/acre-in)

$C_v(i)$ = runoff coefficient for land use (i)

$C_v(i)$ is estimated according to the procedures described above. The values for α are shown in Table 13 below:

TABLE 13					
α FACTORS (*)					
<u>Land Use</u>	<u>Pollutant</u>				
	<u>BOD₅</u> <u>(j=1)</u>	<u>SS</u> <u>(j=2)</u>	<u>VS</u> <u>(j=3)</u>	<u>PO₄</u> <u>(j=4)</u>	<u>N</u> <u>(j=5)</u>
i=1 Residential (α)	0.799	16.3	9.45	0.0336	0.131
i=2 Commercial (α)	3.20	22.2	14.0	0.0757	0.206
i=3 Industrial (α)	1.21	29.1	14.3	0.0705	0.277
i=4 Other Developed Areas (α)	0.113	2.70	2.6	0.00994	0.0605

* units are lb/acre-in.

For the purposes of this section, we have used average $C_v(i)$ values:

for $i = 1$ (Residential), $C_v(1) = .30$

$i = 2$ (Commercial), $C_v(2) = .70$

$i = 3$ (Industrial), $C_v(3) = .60$

$i = 4$ (Other Developed), $C_v(4) = .10$

Table 14 lists the converted "a" factor to be used in equation (3). You may adjust the "a" factor according to equation (4) if you feel that a different runoff coefficient (C_v) is more appropriate for a particular land use in the drainage area.

In order to estimate the population function, $p(PD)$, the following equations are used:

$$\text{for } i = 1 \text{ (Residential): } p(PD) = 0.142 + 0.218 (PD)^{0.54} \quad (5)$$

$$i = 2 \text{ or } 3 \text{ (Commercial or Industrial): } p(PD) = 1.0 \quad (6)$$

$$i = 4 \text{ (Other Developed Areas): } p(PD) = 0.142 \quad (7)$$

where:

PD = population density in people/acres.

Assume the following data inputs:

A) Area = 50 acres

B) Mean rainfall intensity for an average storm = 0.055 in/hr

C), D), E) Land use and C_v values (from Table 14)

Residential = 20 acres; .30

Commercial = 4 acres; .70

Industrial = 0 acres

Other Developed = 4 acres; .10

Open, Undeveloped = 22 acres; 0

F) Population density = 20 people/acre.

Also assume that we are only interested in BOD₅ loading values.

First, calculate $\bar{c}$ values for each land use type in the drainage area using equation (3). To do this, $p(PD)$ values are calculated from equations (5), (6), and (7).

$$\begin{aligned}\text{Residential: } p(PD)_1 &= (0.142 + 0.218 (20)^{0.54}) \\ &= 1.42\end{aligned}$$

$$\begin{aligned}\text{Commercial: } p(PD)_2 &= (1) \\ &= 1.0\end{aligned}$$

$$\begin{aligned}\text{Other: } p(PD)_4 &= (.142) \\ &= .142\end{aligned}$$

Next, calculate the $\bar{c}$ values for each land use type using the above results and Table 14.

$$\text{Residential: } \bar{c}_1 = (11.8) (1.24) = 14.6 \text{ mg/l}$$

$$\text{Commercial: } \bar{c}_2 = (20.2) (1) = 20.2 \text{ mg/l}$$

$$\text{Other: } \bar{c}_4 = (5.0) (.142) = .7 \text{ mg/l}$$

Second, estimate W_R for each of the land use types. This first requires that Q_R be calculated for each land use type of equation $Q_R = C_v IA$.

$$\begin{aligned}\text{Residential: } Q_{R1} &= (.30) \cdot (.055 \text{ in.hr}) \cdot (20 \text{ acres}) \cdot (1 \text{ cfs}/(\text{acre-in/hr})) \\ &= .33 \text{ cfs}\end{aligned}$$

Figure 17. Example of the Application of Step 17, "Assess Impacts From Stormwater Runoff"

Figure 17. cont.

$$\begin{aligned}\text{Commercial: } Q_{R2} &= (.70) \cdot (.055 \text{ in/hr}) \cdot (4) \cdot (1 \text{ cfs}/(\text{acre-in/hr})) \\ &= .15 \text{ cfs}\end{aligned}$$

$$\begin{aligned}\text{Other: } Q_{R4} &= (.10) \cdot (.055 \text{ in/hr}) \cdot (4) \cdot (1 \text{ cfs}/(\text{acre-in/hr})) \\ &= .02 \text{ cfs.}\end{aligned}$$

Now, calculate W_R for land use type, using

$$W_R = 5.4 \cdot \bar{C} \cdot Q_R$$

$$\begin{aligned}\text{Residential: } W_{R1} &= (5.4 \text{ lb/day/cfs-mg/l}) \cdot (14.6 \text{ mg/l}) \cdot (.33 \text{ cfs}) \\ &= 26 \text{ lb/day BOD}_5\end{aligned}$$

$$\begin{aligned}\text{Commercial: } W_{R2} &= (5.4 \text{ lb/day/cfs-mg/l}) \cdot (20.2) \cdot (.15 \text{ cfs}) \\ &= 16.3 \text{ lb/day BOD}_5\end{aligned}$$

$$\begin{aligned}\text{Other: } W_{R4} &= (5.4 \text{ lb/day/cfs-mg/l}) \cdot (.7 \text{ mg/l}) \cdot (.02) \\ &= .07 \text{ lb/day BOD}_5\end{aligned}$$

$$\begin{aligned}W_R \text{ Total} &= W_{R1} + W_{R2} + W_{R4} \\ &= 26 + 16.3 + .07 \\ &= 42.37 \text{ lb/day BOD}_5\end{aligned}$$

This represents the BOD₅ loads for an average storm event. The value is, of course, only useful for this type of screening exercise or where one alternative land use effect is being compared with another one. The vlaue does not take into account site-specific factors as slope and storage.

TABLE 14

"a" FACTORS* FOR GIVEN $C_v(i)$

<u>Land Use</u>	<u>$C_v(i)$</u>	<u>Pollutant</u>				
		<u>BOD₅</u> <u>(j=1)</u>	<u>SS</u> <u>(j=2)</u>	<u>VS</u> <u>(j=3)</u>	<u>PO₄</u> <u>(j=4)</u>	<u>N</u> <u>(j=5)</u>
i=1 Residential (a)	0.30	11.8	240	139	0.50	1.9
i=2 Commercial (a)	0.70	20.2	140	88	0.48	1.9
i=3 Industrial (a)	0.60	8.9	214	105	0.52	2.0
i=4 Other Developed Areas (a)	0.10	5.0	119	115	0.44	2.7

*units are in mg/l.

4.20 STEP 18: ASSESS NOISE IMPACTS

Description

This category is generally most significant as a primary impact resulting from construction or operation of the facility and associated transportation infrastructure. The quantification of noise impacts is difficult, and therefore a primarily qualitative approach is recommended.

Data Output

- A) Identification of noise-sensitive areas affected by increased traffic attributable to the facility.
- B) Identification of residential or service sector growth in areas with high ambient noise levels.

Data Input

- A) Location of new residential development, by community.

Source: Step 13.

- B) Location of new commercial development, by community.

Source: Step 15.

- C) Location of noise-sensitive areas

Source: updated land use map, Step 11.

- D) • pattern of traffic in community.

- expansion of roads and highways necessary to accomodate new traffic.

Source: local traffic engineer or public works official

- E) Location of facility.

Source: Applicant.

- F) Location of potentially high ambient-noise level land uses.

Source: updated land use map, Step 11.

- G) Location of known collocating industries.

Source: Step 21.

Technique

- 1) Present the traffic engineer with the overlays from Steps 13 and 15 which identify the location of new housing and commercial development.

Also, give the engineer the number of new housing units and the associated population. Identify and point out the location of known colocating industries. Ask the engineer to estimate:

- the increase in traffic attributable to the new housing and the facility.
- the increase in traffic between the new housing and commercial facilities.
- the increase in traffic between known colocating facilities and new housing.
- the expansion of roads and highways necessary to accommodate the new traffic. Determine as precisely as possible which roads will require expansion.

You should use this information to pinpoint noise-sensitive areas, such as schools, hospitals, and even private residences, which may be affected by increased traffic. Private residences are included here because they may be affected if the facility has a 3-shift work day. At the end of each shift, noise levels from departing workers may be unacceptable, particularly if these workers leave work during the night.

Based on the overlays, you can pinpoint any residential or commercial growth which will be located in areas with currently high ambient noise levels. Manufacturing and warehouse land uses, and highway/street level uses are most likely to conflict with induced residential or commercial growth. If the community has a noise control official, consult with this individual about potential noise conflicts.

4.21 STEP 19: ASSESS PESTICIDES IMPACTS

Description

There are potential conflicts between agriculture pesticide use and new residential development. The assessment in this step is qualitative.

Data Output

- A) Location of potential conflicts between agricultural pesticide use and new housing.

Data Input

- A) Location of agricultural land uses.

Source: updated land use map, Step 11.

- B) Location of agricultural areas with heavy pesticide use.

Source: local agricultural extension office (USDA) or state department of agriculture.

C) Location of new housing within communities.

Source: Step 13.

Technique

Do this analysis only for communities with new residential development. Consult with the officials listed above to identify areas of heavy pesticide use. Compare these areas to the overlays showing residential growth. Any residential area adjacent to an area of heavy pesticide use is at risk, until mitigation measures can be devised. Identify the types of pesticides being used, and the general pattern of application (time-of-day and frequency of application).

4.22 STEP 20: ASSESS IMPACTS ON SENSITIVE AREAS

Description

This category includes all legally or scientifically defined sensitive areas in any communities expected to absorb new housing units. These areas include:

- wetlands
- floodplains
- coastal zones
- prime and unique agricultural land
- steep slopes
- stream embankments
- historic or archaeological sites
- wildlife habitats
- alluvial valley floors
- forests or woodlands
- sole source aquifers
- seismically active areas
- endangered species habitats
- wild and scenic river
- local, state, or federal recreation area
- areas of particular scenic value.

Data Output

A) Identification and quantification of sensitive areas at risk. (See Figure 18)

Data Input

A) Location of new residential development.

Source: Step 13.

B) Location of new commercial development

Source: Step 15.

C) Location of known colocating industries.

Source: Step 21.

<u>Sensitive Area</u>	<u>Contact</u>
Wetlands and Floodplains	Environmental Office of the Fish and Wildlife Service of the regional office of Department of the Interior (DOI).
Coastal Zone	1) State coastal zone management office, usually a part of the State Office of Environmental Affairs or Natural Resources. 2) The Coastal Zone Information Center or the Director of the State Programs, National Oceanic and Atmospheric Administration.
Prime and Unique Agricultural Land	State Land Use Committee Chairperson, Soil Conservation Service, U.S. Department of Agriculture.
Steep Slopes	U.S.G.S. topographical map.
Stream Embankments	U.S.G.S topographical map or general site location map.
Historic or Archaeological Sites	1) Division of Cultural Resources of the regional office of DOI. 2) National Register of Historic Places.
Wildlife or Endangered Species Habitats	1) Office of Endangered Species of the Office of Federal Assistance, Fish & Wildlife Service at the regional office of DOI. 2) Office of Marine Mammals and Endangered Species of the National Marine Fisheries Services, NOAA.
Alluvial Valley Floors	Office of Environmental Geology, USGS.
Forests or Woodlands	U.S. Forest Service of the regional office of DOI.
Sole Source Aquifer	State Water Resources Division, USGS.

Figure 18 Sources to Contact to Identify Sensitive Areas.

Figure 18 (cont.)

<u>Sensitive Area</u>	<u>Contact</u>
Seismically Active Areas	Office of Earthquake Studies, USGS.
Wild and Scenic Rivers	Heritage, Conservation, and Recreation Service, regional office of DOI.
Local, State or Federal Recreation Area	National Park Service of the regional office of DOI.
Areas of Particular Scenic Value	National Park Service of the regional office of DOI

- D) Location of sensitive areas in any community expected to experience residential growth.

Source: Updated land use map, Step 13. Some sensitive areas may have been identified at Levels A and B.

Technique

Plot the location of sensitive areas on an overlay. Compare this overlay to those developed for Steps 13 and 15, and also compare these overlays to the location of known colocators (Step 21).

- 1) Any sensitive lands adjacent to new housing, new commercial sector activity, or known colocators is assumed to be at risk.
- 2) Land which is considered legally developable under local zoning, but which is also considered sensitive, is assumed to be at risk if it is located in the same community as new housing, new commercial activity, or a known colocator. This land is at risk even if it is not immediately adjacent to the new growth.
- 3) If growth in a community exhausts the supply of legally developable land, then all sensitive areas in the community are assumed to be at risk, regardless of whether they abut the new growth. The results of Steps 11 and 13 will tell you whether all developable land in a community is consumed by residential growth.

4.23 STEP 21: IDENTIFY KNOWN COLOCATORS

Suppliers of raw materials, buyers of finished products, or industries attracted by potential agglomeration economies may colocate with the new source. Steps 22 and 23 can only be undertaken if you can identify specific known colocators. You can identify these companies by consulting with:

- the applicant
- the local economic development agency, and chamber of commerce
- the local or regional planning commission.

Generally speaking, it will not be possible to identify known colocators, given that this colocation is based upon the successful completion of the applicant's facility, and this facility will not yet have received approval to proceed to construction. The adequacy of the transportation network in the United States and in most regions of the country means that colocation within the impact area is not a necessity for the successful operation of a business which buys from or supplies the facility.

In the absence of information about known colocators, do not assume or infer that specific industries will colocate in the impact area. If appropriate, you may include a paragraph in the EIS which details that the location of additional facilities in the impact area may significantly strain the housing

market and available infrastructure, and may lead to additional induced growth with potentially serious physical impacts. Your decision to include this type of very brief analysis will depend on the magnitude of the secondary impacts from the facility itself.

4.24 STEP 22: CALCULATE THE SITE REQUIREMENTS OF KNOWN COLOCATORS

Description

This analysis is undertaken only if the applicant or local officials know of a specific company which is locating within the impact area as a direct result of the development or location of the facility.

Data Output

A) Location of the colocating facility.

Source: applicant; representative of the colocating company; local economic development board; local real estate agent representing the colocating company.

B) Estimated number of acres required by the colocating company for the main facility and associated infrastructure.

Source: same as A).

Technique

Collect the information supplied by the sources listed above. These data are used for the noise and sensitive area evaluations (Steps 18 and 20).

4.25 STEP 23: CALCULATE THE INFRASTRUCTURE REQUIREMENTS OF KNOWN COLOCATORS

Description

This analysis is done only for known colocators. The major infrastructure requirements of interest are:

- water supply
- energy supply
- solid waste collection
- wastewater treatment.

These infrastructure requirements represent only infrastructure essential to construction or operation at the site of the colocator's facility. Infrastructure supplied off-site to employees operating or constructing the facility is considered in Step 14.

Data Output

A) Additional infrastructure required to service the activities that occur at the facility site.

Data Input

A) Location of collocating facility.

Source: Step 21.

B) Number of employees of collocator at peak construction, and during stable operations, and number of operating shifts.

Source: Step 21.

C) Requirements of the facility for the services provided in the four infrastructure categories listed above.

Source: a representative of the collocating company.

D) Acreage of facility.

Source: Step 21.

Technique

In the absence of cooperation from representatives of the collocating company, there are no valid standard multipliers available to quantify these infrastructure requirements; these requirements are highly specific to the construction and operating characteristics of the facility.

Ask a representative of the company to identify and quantify specific infrastructure needs in the four categories listed above. Present these resource estimates to the local utilities, and to local officials responsible for solid waste, wastewater treatment, and water supply, and ask them to identify if available reserve capacity can accommodate the company's needs.

If the representative of the collocating company refuses to cooperate with this analysis, consult the local officials listed above anyway. In the case of a substantial collocator, they should be able to estimate the requirements of the facility, as few companies will select a site for a facility without checking with local officials concerning the adequacy of infrastructure.

4.26: STEP 24: PREPARE THE ENVIRONMENTAL IMPACT STATEMENT

The previous 23 steps have outlined specific steps for the assessment of secondary impacts of new facilities or projects. The results of these assessments should be incorporated into a discrete section of the EIS devoted to these impacts.

In preparing any portion of an Environmental Impact Statement, you should refer to the CEQ "Regulations for Implementing the Procedural Provisions of NEPA,"* and to the regulations of the lead agency responsible for supervising the preparation of the statement. Every Federal agency was required to adopt

*40 CFR 1500 to 1508.

appropriate procedures to supplement the CEQ regulations. EPA promulgated its procedures as 40 CFR 6, "Implementation of Procedures on the National Environmental Policy Act," effective December 15, 1979.

The contents of the EIS should be as follows:*

- a) Cover sheet
- b) Summary
- c) Table of contents
- d) Purpose of and need for action
- e) Alternatives, including proposed action
- f) Affected environment
- g) Environmental consequences**
- h) List of preparers
- i) List of agencies, organizations, and persons to whom copies of the statement are sent
- j) Index
- k) Appendices (if any).

This is a standard format for EISs, which should be followed unless you determine there is a "compelling reason to do otherwise."***Consult the CEQ regulations for a more detailed discussion of the contents of each of these sections.

The section on environmental consequences should include discussions of:

- direct (primary) effects and their significance
- indirect (secondary) effects and their significance+

Secondary effects are the entire focus of this user manual.

We recommend that primary and secondary impacts be treated in separate

*40 CFR 1502.10.

**See especially sections 102(2)(c)(i), (ii), (iv), and (v) of the National Environmental Policy Act.

***40 CFR 1502.10.

+40 CFR 1502.16.

sections of the chapter on "environmental consequences," both because of the very different nature of these two types of impacts, and to emphasize the potential importance of secondary impacts.

The order of exposition of the secondary impacts section of the EIS should follow the order of the steps outlined in this chapter of the user manual. You should emphasize the results from each step of the analysis, rather than the steps used to arrive at these results.

A frequent criticism of EISs is that they are encyclopedic, and it can be exceedingly difficult to identify the major conclusions from the analysis. The CEQ regulations state that

the text of final environmental impact statements shall normally be no less than 150 pages and for proposals of unusual scope or complexity, shall normally be less than 300 pages.*

Therefore, although documentation of the steps you used to reach a particular result is essential, you should severely curtail the amount of documentation in the EIS. This documentation should, however, be available outside of the EIS itself for you or other individuals to reference.

*40 CFR 1502.7.

APPENDIX I.A: Equation for Indirect Employment and Population Impacts

Both Level B and Level C require the calculation of the total direct and indirect population and employment effects attributable to the location of a facility in the impact area. To calculate these effects, the user estimates population and employment multipliers. A more detailed derivation of these multipliers is given below.

Let E be the increment in basic employment because of the new source

$$\text{in general } \alpha = \frac{P}{T}, \beta = \frac{S}{P}$$

define the population and employment impacts from E in the ith round as $\hat{P}(i)$ and $\hat{S}(i)$, respectively, then

$$\begin{aligned}\hat{P}(1) &= \alpha E \\ \hat{S}(1) &= \beta \hat{P}(1) = \alpha \beta E \\ \hat{P}(2) &= \alpha \hat{S}(1) = \alpha^2 \beta E \\ \hat{S}(2) &= \beta \hat{P}(2) = (\alpha \beta)^2 E\end{aligned}$$

$$\begin{aligned}\hat{P}(n) &= \alpha (\alpha \beta)^{n-1} E \\ \hat{S}(n) &= (\alpha \beta)^n E\end{aligned}$$

$$\begin{aligned}\text{therefore, } \hat{P} &= \hat{P}(1) + \hat{P}(2) + \dots + \hat{P}(n) + \dots \\ &= \alpha E + \alpha (\alpha \beta) E + \dots + \alpha (\alpha \beta)^{n-1} E + \dots \\ &= \alpha E \sum_{i=0}^{\infty} (\alpha \beta)^i\end{aligned}$$

$$\text{Total population, } (P_T) = \frac{\alpha E}{1 - \alpha \beta}$$

similarly, the total employment impact (E_T) from the new source is direct employment, E, plus indirect employment, $\hat{S}$

$$\begin{aligned}\text{and } E_T &= E + S(1) + S(2) + \dots + S(n) + \dots \\ &= E + \alpha \beta E + (\alpha \beta)^2 E + \dots + (\alpha \beta)^n E + \dots \\ &= E \sum_{i=0}^{\infty} (\alpha \beta)^i\end{aligned}$$

$$\text{or, } E_T = \frac{E}{1 - \alpha \beta}$$

APPENDIX I.B: Calculating Costs for Standard Facilities

Costs for standard facilities may be estimated by using McGraw Hill's Dodge Building Cost Calculator and Valuation Guide which is available in yearly subscriptions consisting of an original guide and three quarterly updates. Since the guide's primary goal is to estimate current costs, it is essential that the most recent issue be used. The costs listed in the guide are based on actual prices for construction contracted in all regions of the United States. In order to arrive at estimates that are "reasonably correct," costs at the low-to-mid range of competitive bidding are listed. The guide excludes any land costs, closing costs or financing charges associated with the facility. Included, however, is a set of conditions to be considered when choosing a site for construction.

The guide is divided into six sections representing major classifications of facilities: residential, commercial and industrial, educational and religious, public, medical, and rural. Under each of these classifications are several specific building types. For example, eight types of public buildings are listed -- fire stations, municipal buildings, armories, public libraries, telephone buildings, clubs, health and recreational buildings, and air terminals. The first step in using the guide is to locate the appropriate type of building desired. Next, the construction method used (steel and concrete frame, masonry wall, etc.) and quality of the building are considered. Once these characteristics are identified, a description of a model building in terms of structure, plumbing, heating, ventilation, air conditioning, wiring, flooring, built-in equipment and functional areas along with pictures of representative buildings, can be located in the guide. Next, the gross floor area of the proposed building is calculated by estimation techniques set forth by the American Institute of Architects. The gross floor area is used to determine the base cost per square foot of the proposed building. Changes to the base cost are made if any particular aspects of the proposed building differ from those of the model building featured in the guide. Base costs for any special areas not included in the model, such as elevators and decks, are also determined.

The final step is to arrive at an appropriate "local cost multiplier", since the base costs per square foot were calculated for the base year of 1970. Specific cities throughout the U.S. have multipliers for four construction methods: steel construction, masonry construction (including concrete), frame construction, and average construction, a category to be used when the above methods are combined. Multipliers apply to any location within a 25 mile radius of the city. If a multiplier is needed for any area not covered in the guide, the editors of the guide will develop one for a subscriber at no extra charge, if supplied with basic information about the location. Once the multiplier has been determined, it is multiplied by the total base cost to determine the total estimated cost of the building.

APPENDIX I.C: Summary of Construction Worker Case Studies

One group of individuals that may have a strong impact on the region where a new source facility - particularly a large scale energy or resource development project - is sited is the team of construction workers. Construction time for a major facility generally ranges from 5-15 years. Since the average construction worker works on the facility for the life of the project, his/her presence in the community is felt for a considerable length of time. Several case studies have analyzed the effects of these workers on affected communities in Louisiana, Wyoming, Montana, North Dakota, Utah, Alaska, Oregon, Nebraska, Washington, Idaho and Pennsylvania. (See list of sources at the end of this section.)

The population influx attributable to construction workers who move into the impact area is dependent upon

- the percentage of workers who have families,
- the proportion of workers who bring their families to the impact area,
- the average family size of construction workers.

While the findings vary, most studies indicate that 200 to 300 people total will enter the impact area for each 100 construction workers.

Average family size for construction workers is fairly stable across all studies we have reviewed. There is some evidence that the family size of construction workers is generally lower than the average for families already residing in the impact area.

The percentage of construction workers who move into the impact area with their families is dependent on the length of the project, feasibility of commuting to the region from other areas, and availability and type of housing in the siting area. Construction workers are often willing to drive 1 to 1½ hours or 60 to 70 miles for a one-way commute to the construction site.

Housing Impacts

The strain on local housing markets is regarded as one of the most serious negative effects associated with the population growth which may accompany a new facility. According to the Wyoming Department of Economic Planning & Development, "housing is often the most immediate and critical area associated with boomtown impact because of the complex process involved in satisfying housing requirements."*

The key to the housing problem is the excess demand for housing that may be created by a population categorized as "temporary." The fact that construction workers are not permanent residents of the area has implications for both

*Dept. of Economic Planning & Development, Office of the Chief of State Planning, Housing Finance: Implications for the State of Wyoming, Cheyenne, Wyoming (March 1977).

the price and type of housing that will be available.

The increased demand for housing is reflected most strongly in the demand for single family housing. Most construction workers prefer single family homes, although they may not in every case be able to afford them. As demand increases for single-family housing, prices increase, ceteris paribus. This price increase further prevents some workers who desire single-family homes from purchasing them. This situation may be worsened by the fact that existing houses may be condemned to allow for the physical siting of the facility and buffer zones, or may become less desirable because of proximity to the facility.

The provision of new housing may not occur as quickly as desired for several reasons. Houses built in a short period of time are generally of a lesser quality, and many local builders are unwilling to build such "cut-rate" homes. Modular prefabricated houses, although a likely solution, may be ruled out by local rules and builder's preferences. Financing from local sources of funds may be difficult to obtain, or the cost of financing a home through available funds may be prohibitive.* Due to the fact that large-scale industrial plants are often sited in areas remote from any large population center, the supply of houses may already be tight; in rural areas, little speculative building occurs, and houses are often custom-built.

As a result of the shortages of single-family housing, workers must seek alternate modes of housing. Mobile homes often accommodate those workers unable to find suitable housing elsewhere; however, the general sentiment of construction workers is that mobile homes are undesirable. Many workers choose to live instead in "temporary" forms of housing such as boarding rooms, motel rooms, and recreational vehicles other than mobile homes. In addition, sub-standard housing that was not in use before construction began may be utilized. The conversion of one-family houses to two-family houses may also occur.

Despite the increase in available housing caused by the easing of quality standards, mobile homes accommodate many construction workers. From 1970-1974, the incidence of mobile homes in Sweetwater County, Wyoming rose 760%, largely as a result of the Jim Bridger Project, a 2,000 megawatt power plant.■

It should be noted that the housing situation may strongly affect the ability of the community's infrastructure to respond to the strain resulting from the population increase in the region. Concerned communities that try to recruit doctors, teachers, etc. to the area will have difficulty doing so if the available housing is inadequate.

*Lack of funds may be due to a tight money market, or be attributable to banker's prejudices against construction workers.

■Campbell, Kimberly A., Case Studies on Energy Impact No. 2: Controlling Boom Town Development in Sweetwater and Uinta Counties, Wyoming. National Association of Counties, Washington D.C., 1976.

LIST OF SOURCES FOR CONSTRUCTION WORKER CASE STUDIES

Baldwin, Thomas E. and Roberta Poetsch, An Approach to Assessing Local Sociocultural Impacts Using Projections of Population Growth and Composition. Argonne National Laboratory, Argonne, Illinois, 1977.

Greene, Marjorie R. and Martha G. Curry, The Management of Social and Economic Impacts Associated with the Construction of Large-Scale Projects: Experiences from the Western Coal Development Communities. Battelle Pacific Northwest Laboratories, Richland, Washington, 1977.

Institute for Policy Research, University of Wyoming, Socioeconomic Longitudinal Monitoring Project. The Old West Regional Commission, Billings, Montana, 1979.

Pennsylvania Power and Light Company, Community Affairs Department, A Monitoring Study of Community Impacts for the Susquehanna Steam Electric Station. Pennsylvania Power & Light Company, Allentown, Pennsylvania, 1976.

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Mountain West Research, Inc., Construction Worker Profile. The Old West Regional Commission, Billings, Montana, 1975.

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USR&E, Employment Growth in Rural Areas, Office of Economic Opportunity, Washington, D.C. 20506.

University of Wyoming, Black Thunder Project Research team, Final Environmental Assessment: Black Thunder Mine Site, October 1976.

APPENDIX 1-D

NATIONWIDE AVERAGE MOTOR VEHICLE EMISSION
RATES FOR NMHC, CO, AND NO_x

MOBILE1 INPUT DATA ASSUMPTIONS

Motor Vehicle Mix by Type

80.3% Light-duty vehicles (LDV)
5.8% Light-duty trucks, 0-6000 lb GVW* (LDT1)
5.8% Light-duty trucks, over 6000 lb GVW (LDT2)
4.5% Heavy-duty gasoline trucks (HDG)
3.1% Heavy-duty diesel trucks (HDD)
0.5% Motorcycles (MC)

100.0%

Vehicle Operation Mode

20.6% cold start mode
27.3% hot start mode
52.1% not stabilized mode

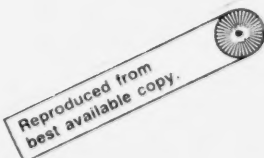
100.0%

Ambient Temperature: 60°F

Average Vehicle Speed: 30 mph

Geographic Region: Low Altitude, California, and High-Altitude (Above 4000' MSL)

Year of Composite Emissions: 1980 through 1999 inclusive.



*Gross vehicle weight

[illegible]

EXHAUST NEX:	CC: 11.01	20.91 2.34	20.61 2.51	90.19 7.82	16.75 6.63	3.50 0.19	17.29 2.31
CAL. YEAR: 1992 REGION: 49-STATE							
TEMP: 60.0(F)	VEH. TYPE: LDV	LDV	LDV	LDV	LDV	LDV	LDV
30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0
COMPOSITE EMISSION FACTORS (GM/MILE)							
LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV
1.24	1.24	1.73	2.37	4.76	1.90	0.38	1.51
EXHAUST CC:	11.55	19.55	24.83	92.57	16.73	3.27	16.68
EXHAUST NEX:	1.84	2.32	2.44	7.65	6.05	0.18	2.27
CAL. YEAR: 1993 REGION: 49-STATE							
TEMP: 60.0(F)	VEH. TYPE: LDV	LDV	LDV	LDV	LDV	LDV	LDV
30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0
COMPOSITE EMISSION FACTORS (GM/MILE)							
LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV
1.24	1.24	1.54	2.20	4.55	1.85	0.36	1.47
EXHAUST CC:	11.24	18.50	23.16	93.32	16.72	3.20	16.22
EXHAUST NEX:	1.84	2.32	2.35	7.55	5.65	0.18	2.25
CAL. YEAR: 1994 REGION: 49-STATE							
TEMP: 60.0(F)	VEH. TYPE: LDV	LDV	LDV	LDV	LDV	LDV	LDV
30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0
COMPOSITE EMISSION FACTORS (GM/MILE)							
LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV
1.21	1.21	1.58	2.05	4.42	1.64	0.35	1.44
EXHAUST CC:	11.11	17.76	21.91	91.86	16.72	3.16	15.69
EXHAUST NEX:	1.84	2.33	2.35	7.55	5.38	0.16	2.24
CAL. YEAR: 1995 REGION: 49-STATE							
TEMP: 60.0(F)	VEH. TYPE: LDV	LDV	LDV	LDV	LDV	LDV	LDV
30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0
COMPOSITE EMISSION FACTORS (GM/MILE)							
LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV
1.20	1.20	1.53	1.91	4.26	1.86	0.31	1.42
EXHAUST CC:	11.05	16.99	20.54	91.36	16.71	3.05	15.64
EXHAUST NEX:	1.84	2.34	2.32	7.53	5.18	0.18	2.23
CAL. YEAR: 1996 REGION: 49-STATE							
TEMP: 60.0(F)	VEH. TYPE: LDV	LDV	LDV	LDV	LDV	LDV	LDV
30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0
COMPOSITE EMISSION FACTORS (GM/MILE)							
LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV
1.20	1.20	1.53	1.91	4.26	1.86	0.31	1.42
EXHAUST CC:	11.05	16.99	20.54	91.36	16.71	3.05	15.64
EXHAUST NEX:	1.84	2.34	2.32	7.53	5.18	0.16	2.23
CAL. YEAR: 1997 REGION: 49-STATE							
TEMP: 60.0(F)	VEH. TYPE: LDV	LDV	LDV	LDV	LDV	LDV	LDV
30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0
COMPOSITE EMISSION FACTORS (GM/MILE)							
LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV
1.20	1.20	1.53	1.91	4.26	1.86	0.31	1.42
EXHAUST CC:	11.05	16.99	20.54	91.36	16.71	3.05	15.64
EXHAUST NEX:	1.84	2.34	2.32	7.53	5.18	0.16	2.23
CAL. YEAR: 1998 REGION: 49-STATE							
TEMP: 60.0(F)	VEH. TYPE: LDV	LDV	LDV	LDV	LDV	LDV	LDV
30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0	30.0:30.0/30.0/30.0
COMPOSITE EMISSION FACTORS (GM/MILE)							
LDV	LDV	LDV	LDV	LDV	LDV	LDV	LDV
1.20	1.20	1.53	1.91	4.26	1.86	0.31	1.42
EXHAUST CC:	11.05	16.99	20.54	91.36	16.71	3.05	15.64
EXHAUST NEX:	1.84	2.34	2.32	7.53	5.18	0.16	2.23

EXHAUST NOX:	1.24	2.34	2.32	7.53	5.12	6.18	2.23
CAL. YEAR: 1993			VEH. TYPE:	LUV	LOT1	LOT2	HDD
REGION: 49-STATE			TEMP: 60.0(F)	0.803/C.058/30.0 MPH	0.058/C.058/30.0	0.058/C.058/30.0	0.058/C.058/30.0
			COMPOSITE EMISSION FACTORS (GM/MILE)				
	LUV	LOT1	LOT2	HDD	HDD	HDD	ALL MILES
NON-METH HC:	1.20	1.53	1.91	4.26	1.86	0.31	1.42
EXHAUST CO:	11.05	16.99	20.54	90.30	16.71	3.05	15.64
EXHAUST NOX:	1.84	2.34	2.32	7.53	5.12	0.18	2.23
CAL. YEAR: 1999			VEH. TYPE:	LUV	LOT1	LOT2	HDD
REGION: 49-STATE			TEMP: 60.0(F)	0.803/C.058/30.0 MPH	0.058/C.058/30.0	0.058/C.058/30.0	0.058/C.058/30.0
			COMPOSITE EMISSION FACTORS (GM/MILE)				
	LUV	LOT1	LOT2	HDD	HDD	HDD	ALL MILES
NON-METH HC:	1.20	1.53	1.91	4.26	1.86	0.31	1.42
EXHAUST CO:	11.05	16.99	20.54	90.30	16.71	3.05	15.64
EXHAUST NOX:	1.84	2.34	2.32	7.53	5.12	0.18	2.23
CAL. YEAR: 1993			VEH. TYPE:	LUV	LOT1	LOT2	HDD
REGION: CALIF.			TEMP: 60.0(F)	0.803/C.058/30.0 MPH	0.058/C.058/30.0	0.058/C.058/30.0	0.058/C.058/30.0
			COMPOSITE EMISSION FACTORS (GM/MILE)				
	LUV	LOT1	LOT2	HDD	HDD	HDD	ALL MILES
NON-METH HC:	4.01	4.70	7.46	10.75	3.95	4.86	4.53
EXHAUST CO:	29.16	42.24	52.62	189.80	17.52	22.54	38.12
EXHAUST NOX:	2.52	2.80	4.71	9.84	16.71	0.26	3.42
CAL. YEAR: 1993			VEH. TYPE:	LUV	LOT1	LOT2	HDD
REGION: CALIF.			TEMP: 60.0(F)	0.803/C.058/30.0 MPH	0.058/C.058/30.0	0.058/C.058/30.0	0.058/C.058/30.0
			COMPOSITE EMISSION FACTORS (GM/MILE)				
	LUV	LOT1	LOT2	HDD	HDD	HDD	ALL MILES
NON-METH HC:	3.42	4.10	6.60	9.47	2.93	5.60	3.91
EXHAUST CO:	25.05	38.83	50.27	191.83	17.22	19.82	35.03
EXHAUST NOX:	2.30	2.66	4.27	9.40	16.16	0.36	3.18
CAL. YEAR: 1982			VEH. TYPE:	LUV	LOT1	LOT2	HDD
REGION: CALIF.			TEMP: 60.0(F)	0.803/C.058/30.0 MPH	0.058/C.058/30.0	0.058/C.058/30.0	0.058/C.058/30.0
			COMPOSITE EMISSION FACTORS (GM/MILE)				
	LUV	LOT1	LOT2	HDD	HDD	HDD	ALL MILES
NON-METH HC:	2.90	3.63	5.86	8.36	2.92	4.18	3.20
EXHAUST CO:	22.47	35.19	47.24	193.34	17.12	18.03	32.14
EXHAUST NOX:	2.14	2.54	3.85	9.00	15.67	0.44	2.50
CAL. YEAR: 1993			VEH. TYPE:	LUV	LOT1	LOT2	HDD
REGION: CALIF.			TEMP: 60.0(F)	0.803/C.058/30.0 MPH	0.058/C.058/30.0	0.058/C.058/30.0	0.058/C.058/30.0
			COMPOSITE EMISSION FACTORS (GM/MILE)				
	LUV	LOT1	LOT2	HDD	HDD	HDD	ALL MILES
NON-METH HC:	2.40	3.13	5.17	7.34	2.81	3.07	2.89
EXHAUST CO:	19.81	32.08	45.93	182.59	17.01	18.84	25.28
EXHAUST NOX:	2.52	2.42	3.50	8.64	15.26	0.48	2.83

[illegible]

CAL. YEAR: 1990 REGION: CALIF.	LEV 1.31 13.02 1.75	VEH. TYPE: TEMP: 60.0(F) 30.0/30.0/30.0/30.0 MPH	LDV C.803/C.058/0.045/0.031/0.005	LOT1 20.6/27.3/20.6	LOT2 20.6/27.3/20.6	HDG 0.47 3.98 0.12	MC 0.47 3.98 0.12	ALL MCDES 1.55 18.28 2.16
COMPOSITE EMISSION FACTORS (GM/MILE)								
NON-MLTH HC: EXHAUST CO: EXHAUST NOX:	LEV 1.31 13.02 1.75	LOT1 2.36 25.12 2.46	HDG 4.46 105.07 6.95	LOT1 1.95 16.73 6.88	LOT2 1.95 16.73 6.88	HDG 0.47 3.98 0.12	MC 0.47 3.98 0.12	ALL MCDES 1.55 18.28 2.16
CAL. YEAR: 1991 REGION: CALIF.	LEV 1.28 12.80 1.74	VEH. TYPE: TEMP: 60.0(F) 30.0/30.0/30.0/30.0 MPH	LDV 0.803/C.058/0.045/0.031/0.005	LOT1 20.6/27.3/20.6	LOT2 20.6/27.3/20.6	HDG 0.47 3.98 0.12	MC 0.47 3.98 0.12	ALL MCDES 1.55 18.28 2.16
COMPOSITE EMISSION FACTORS (GM/MILE)								
NON-MLTH HC: EXHAUST CO: EXHAUST NOX:	LEV 1.28 12.80 1.74	LOT1 2.20 23.51 2.43	HDG 4.26 100.64 6.97	LOT1 1.92 16.72 6.21	LOT2 1.92 16.72 6.21	HDG 0.41 3.45 0.17	MC 0.41 3.45 0.17	ALL MCDES 1.50 17.75 2.16
CAL. YEAR: 1992 REGION: CALIF.	LEV 1.26 12.61 1.74	VEH. TYPE: TEMP: 60.0(F) 30.0/30.0/30.0/30.0 MPH	LDV 0.803/C.058/0.045/0.031/0.005	LOT1 20.6/27.3/20.6	LOT2 20.6/27.3/20.6	HDG 0.45 3.98 0.12	MC 0.45 3.98 0.12	ALL MCDES 1.50 18.28 2.16
COMPOSITE EMISSION FACTORS (GM/MILE)								
NON-MLTH HC: EXHAUST CO: EXHAUST NOX:	LEV 1.26 12.61 1.74	LOT1 2.04 22.33 2.40	HDG 4.13 97.23 6.95	LOT1 1.90 16.71 5.75	LOT2 1.90 16.71 5.75	HDG 0.38 3.37 0.17	MC 0.38 3.37 0.17	ALL MCDES 1.46 17.32 2.14
CAL. YEAR: 1993 REGION: CALIF.	LEV 1.24 12.44 1.74	VEH. TYPE: TEMP: 60.0(F) 30.0/30.0/30.0/30.0 MPH	LDV 0.803/C.058/0.045/0.031/0.005	LOT1 20.6/27.3/20.6	LOT2 20.6/27.3/20.6	HDG 0.45 3.98 0.12	MC 0.45 3.98 0.12	ALL MCDES 1.46 18.28 2.16
COMPOSITE EMISSION FACTORS (GM/MILE)								
NON-MLTH HC: EXHAUST CO: EXHAUST NOX:	LEV 1.24 12.44 1.74	LOT1 1.89 21.01 2.37	HDG 4.00 94.80 7.04	LOT1 1.88 16.71 5.44	LOT2 1.88 16.71 5.44	HDG 0.37 3.29 0.17	MC 0.37 3.29 0.17	ALL MCDES 1.43 16.55 2.13
CAL. YEAR: 1994 REGION: CALIF.	LEV 1.22 12.30 1.74	VEH. TYPE: TEMP: 60.0(F) 30.0/30.0/30.0/30.0 MPH	LDV 0.803/C.058/0.045/0.031/0.005	LOT1 20.6/27.3/20.6	LOT2 20.6/27.3/20.6	HDG 0.45 3.98 0.12	MC 0.45 3.98 0.12	ALL MCDES 1.43 18.28 2.16
COMPOSITE EMISSION FACTORS (GM/MILE)								
NON-MLTH HC: EXHAUST CO: EXHAUST NOX:	LEV 1.22 12.30 1.74	LOT1 1.75 19.79 2.30	HDG 3.38 93.20 7.09	LOT1 1.87 16.71 5.22	LOT2 1.87 16.71 5.22	HDG 0.34 3.23 0.16	MC 0.34 3.23 0.16	ALL MCDES 1.40 16.60 2.13
CAL. YEAR: 1995 REGION: CALIF.	LEV 1.21 12.26 1.74	VEH. TYPE: TEMP: 60.0(F) 30.0/30.0/30.0/30.0 MPH	LDV 0.803/C.058/0.045/0.031/0.005	LOT1 20.6/27.3/20.6	LOT2 20.6/27.3/20.6	HDG 0.45 3.98 0.12	MC 0.45 3.98 0.12	ALL MCDES 1.40 18.28 2.16
COMPOSITE EMISSION FACTORS (GM/MILE)								
NON-MLTH HC: EXHAUST CO: EXHAUST NOX:	LEV 1.21 12.26 1.74	LOT1 1.63 18.63 2.34	HDG 3.84 91.20 7.16	LOT1 1.86 16.71 5.06	LOT2 1.86 16.71 5.06	HDG 0.34 3.10 0.16	MC 0.34 3.10 0.16	ALL MCDES 1.38 16.40 2.13

CAL. YEAR: 1996
 REGION: CALIF.
 TEMP: 60.0 C(F)
 30.0:30.0/30.0/30.0 MPH (30.0) 0.803/C.058/0.045/0.031/0.005
 20.6/ 27.3/ 20.6

NON-MLTH HC: EXHAUST CO: EXHAUST NLX:	LUV 1.21 12.28 1.74	COMPOSITE EMISSION FACTORS (GM/MILE)					ALL MLDLDES		
		LOT1	LOT2	HDD	HDD	MC	MC	HDD	PC
		1.36	1.63	3.84	1.86	0.34	0.34	1.38	
		15.09	18.69	51.20	16.71	3.10	3.10	16.46	
		1.91	2.34	7.16	5.06	0.16	0.16	2.13	

CAL. YEAR: 1997
 REGION: CALIF.
 TEMP: 60.0 C(F)
 30.0:30.0/30.0/30.0 MPH (30.0) 0.803/C.058/0.045/0.031/0.005
 20.6/ 27.3/ 20.6

NON-MLTH HC: EXHAUST CO: EXHAUST NLX:	LUV 1.21 12.28 1.74	COMPOSITE EMISSION FACTORS (GM/MILE)					ALL MLDLDES		
		LOT1	LOT2	HDD	HDD	MC	MC	HDD	PC
		1.36	1.63	3.84	1.86	0.34	0.34	1.38	
		15.09	18.69	51.20	16.71	3.10	3.10	16.46	
		1.91	2.34	7.16	5.06	0.16	0.16	2.13	

CAL. YEAR: 1998
 REGION: CALIF.
 TEMP: 60.0 C(F)
 30.0:30.0/30.0/30.0 MPH (30.0) 0.803/C.058/0.045/0.031/0.005
 20.6/ 27.3/ 20.6

NON-MLTH HC: EXHAUST CO: EXHAUST NLX:	LUV 1.21 12.28 1.74	COMPOSITE EMISSION FACTORS (GM/MILE)					ALL MLDLDES		
		LOT1	LOT2	HDD	HDD	MC	MC	HDD	PC
		1.36	1.63	3.84	1.86	0.34	0.34	1.38	
		15.09	18.69	51.20	16.71	3.10	3.10	16.46	
		1.91	2.34	7.16	5.06	0.16	0.16	2.13	

CAL. YEAR: 1999
 REGION: CALIF.
 TEMP: 60.0 C(F)
 30.0:30.0/30.0/30.0 MPH (30.0) 0.803/C.058/0.045/0.031/0.005
 20.6/ 27.3/ 20.6

NON-MLTH HC: EXHAUST CO: EXHAUST NLX:	LUV 1.21 12.28 1.74	COMPOSITE EMISSION FACTORS (GM/MILE)					ALL MLDLDES		
		LOT1	LOT2	HDD	HDD	MC	MC	HDD	PC
		1.36	1.63	3.84	1.86	0.34	0.34	1.38	
		15.09	18.69	51.20	16.71	3.10	3.10	16.46	
		1.91	2.34	7.16	5.06	0.16	0.16	2.13	

CAL. YEAR: 1999
 REGION: HI-ALT.
 TEMP: 60.0 C(F)
 30.0:30.0/30.0/30.0 MPH (30.0) 0.803/C.058/0.045/0.031/0.005
 20.6/ 27.3/ 20.6

NON-MLTH HC: EXHAUST CO: EXHAUST NLX:	LUV 1.21 12.28 1.74	COMPOSITE EMISSION FACTORS (GM/MILE)					ALL MLDLDES		
		LOT1	LOT2	HDD	HDD	MC	MC	HDD	PC
		1.36	1.63	3.84	1.86	0.34	0.34	1.38	
		15.09	18.69	51.20	16.71	3.10	3.10	16.46	
		1.91	2.34	7.16	5.06	0.16	0.16	2.13	

CAL. YEAR: 1981
 REGION: HI-ALT.
 TEMP: 60.0 C(F)
 30.0:30.0/30.0/30.0 MPH (30.0) 0.803/C.058/0.045/0.031/0.005
 20.6/ 27.3/ 20.6

NON-MLTH HC: EXHAUST CO: EXHAUST NLX:	LUV 1.21 12.28 1.74	COMPOSITE EMISSION FACTORS (GM/MILE)					ALL MLDLDES		
		LOT1	LOT2	HDD	HDD	MC	MC	HDD	PC
		1.36	1.63	3.84	1.86	0.34	0.34	1.38	
		15.09	18.69	51.20	16.71	3.10	3.10	16.46	
		1.91	2.34	7.16	5.06	0.16	0.16	2.13	

CAL. YEAR: 1982
 REGION: HI-ALT.
 TEMP: 60.0 C(F)
 30.0:30.0/30.0/30.0 MPH (30.0) 0.803/C.058/0.045/0.031/0.005
 20.6/ 27.3/ 20.6

NON-MLTH HC: EXHAUST CO: EXHAUST NLX:	LUV 1.21 12.28 1.74	COMPOSITE EMISSION FACTORS (GM/MILE)					ALL MLDLDES		
		LOT1	LOT2	HDD	HDD	MC	MC	HDD	PC
		1.36	1.63	3.84	1.86	0.34	0.34	1.38	
		15.09	18.69	51.20	16.71	3.10	3.10	16.46	
		1.91	2.34	7.16	5.06	0.16	0.16	2.13	

NON-REF HC: EXHAUST CO: EXHAUST NOX:	LDV 1.55 15.79 1.53	COMPOSITE EMISSION FACTORS (GM/MILE)							ALL MODES	
		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.10	2.38
CAL. YEAR: 1989 REGION: HI-ALT.		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.10	2.38
		1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.10	2.38
NON-REF HC: EXHAUST CO: EXHAUST NOX:	LDV 1.44 14.26 1.82	COMPOSITE EMISSION FACTORS (GM/MILE)							ALL MODES	
		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.44	1.44	1.44	1.44	1.44	1.44	1.44	0.87	1.51
CAL. YEAR: 1990 REGION: HI-ALT.		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.44	1.44	1.44	1.44	1.44	1.44	1.44	0.87	1.51
		1.44	1.44	1.44	1.44	1.44	1.44	1.44	0.87	1.51
NON-REF HC: EXHAUST CO: EXHAUST NOX:	LDV 1.37 13.24 1.82	COMPOSITE EMISSION FACTORS (GM/MILE)							ALL MODES	
		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.37	1.37	1.37	1.37	1.37	1.37	1.37	0.68	1.79
CAL. YEAR: 1991 REGION: HI-ALT.		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.37	1.37	1.37	1.37	1.37	1.37	1.37	0.68	1.79
		1.37	1.37	1.37	1.37	1.37	1.37	1.37	0.68	1.79
NON-REF HC: EXHAUST CO: EXHAUST NOX:	LDV 1.31 12.51 1.82	COMPOSITE EMISSION FACTORS (GM/MILE)							ALL MODES	
		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.31	1.31	1.31	1.31	1.31	1.31	1.31	0.56	1.69
CAL. YEAR: 1992 REGION: HI-ALT.		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.31	1.31	1.31	1.31	1.31	1.31	1.31	0.56	1.69
		1.31	1.31	1.31	1.31	1.31	1.31	1.31	0.56	1.69
NON-REF HC: EXHAUST CO: EXHAUST NOX:	LDV 1.27 11.99 1.82	COMPOSITE EMISSION FACTORS (GM/MILE)							ALL MODES	
		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.27	1.27	1.27	1.27	1.27	1.27	1.27	0.45	1.61
CAL. YEAR: 1993 REGION: HI-ALT.		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.27	1.27	1.27	1.27	1.27	1.27	1.27	0.45	1.61
		1.27	1.27	1.27	1.27	1.27	1.27	1.27	0.45	1.61
NON-REF HC: EXHAUST CO: EXHAUST NOX:	LDV 1.24 11.57 1.82	COMPOSITE EMISSION FACTORS (GM/MILE)							ALL MODES	
		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.24	1.24	1.24	1.24	1.24	1.24	1.24	0.42	1.54
CAL. YEAR: 1994 REGION: HI-ALT.		LDV	LDV	LDV	LDV	LDV	LDV	LDV	MC	PC
		1.24	1.24	1.24	1.24	1.24	1.24	1.24	0.42	1.54
		1.24	1.24	1.24	1.24	1.24	1.24	1.24	0.42	1.54

APPENDIX 1-E

NATIONWIDE AVERAGE MOTOR VEHICLE EMISSION RATES FOR TSP, PB, AND SO_x

Calculation of Lead (Pb) Emission Rates

Motor vehicle lead emission rates vary primarily with the lead content of gasoline, the fraction of lead retained within the exhaust system of the vehicle, and its fuel economy. Indirectly, vehicle speed and calendar year also affect mobile source lead emissions. Emission rates were calculated using the following equation:

$$E = PB \times FR \div GM$$

where: PB = average lead content of gasoline (g/gal), a function of year, see Table E-1.

FR = fraction of combusted lead that is emitted by the vehicle, for 30 mph this is 0.23.

GM = average fuel economy (mi/gal), a function of year, see Table E-2.

Numerical results are independent of region and are given by calendar year in Section 4.20.

Calculation of Particulate (TSP) Emission Rates

Motor vehicle emission rates for particulates are given in EPA's AP-42 publication* for vehicles burning leaded or unleaded gasoline; no listing for a mixture of such vehicles by calendar year is shown. To obtain the temporal variation due to changes in lead emission rates, the particulate emission rate for unleaded gasoline in light duty vehicles (0.05 g/mi exhaust plus 0.20 g/mi tire wear) was assumed to apply in the year 1999 and additions to this value

*EPA Office of Air Quality Planning and Standards, Compilation of Air Pollutant Emission Factors, Third Edition, Supplements 1-10, Publication No. AP-42, Research Triangle Park, NC, 1980.

TABLE E-1
 POOLED AVERAGE
 LEAD CONTENT OF GASOLINE BURNED BY VEHICLE POPULATION*

Year	Lead Content (g/gal)
1974	2.0
1975	1.7
1976	1.4
1977	1.0
1978	0.80
1979	0.50
1980	0.50
1981	0.50
1982	0.34
1983	0.25
1984	0.19
1985	0.15
1986	0.13
1987	0.11
1988	0.09
1989	0.08
1990 - 1999	0.05

*U.S. Environmental Protection Agency, Supplemental Guidelines for Lead Implementation Plans, EPA-450/2-78-038, Research Triangle Park, NC, 1978.

TABLE E-2
AVERAGE FLEET FUEL ECONOMY*

Calendar Year	Fuel Economy (mi/gal)
1974-1976	12.4
1977	13.3
1978	14.0
1979	14.8
1980	15.7
1981-1982	16.8
1983-1984	19.1
1985-1989	21.7
1990-1994	26.2
1995-1999	27.4

*U.S. Environmental Protection Agency, A Report on Automotive Fuel Economy, Washington, D.C., February, 1974.

15 USC 2002, enacted December 22, 1975.

were made for earlier calendar years to account for the increased lead emissions. These light-duty vehicle TSP emission rates were combined with heavy-duty factors given in AP-42. The resulting TSP emission rates are summarized, by year, in Section 4.20.

Calculation of Sulfur Oxide (SO_x) Emission Rates

Motor vehicle emission rates for sulfur oxides are taken from EPA's AP-42 publication and weighted by the assumed percentages of light and heavy-duty vehicles in the population. The resulting SO_x emission rate, independent of region and calendar year, is included in Section 4.20.

APPENDIX I-F: OBERS Methodology¹

In 1972, the Water Resources Council published projections of economic activity for the nation and a number of regional groupings, including states, water resources regions, and SMSAs. Included were projections of population, personal income, employment, and earnings of persons by industry,² for 1980, 1985, 1990, 2000, and 2020. The projections were the joint effort of the Bureau of Economic Analysis³ (BEA) of the Department of Commerce, and the Economics, Statistics & Cooperative Service⁴ of the United States Department of Agriculture. The projection program acquired the acronym OBERS, based upon the former names of the two groups.

The 1972 OBERS projections were based upon the 1967 Series C population projections of the Census Bureau. Series C assumes high birth rates which, though somewhat lower than the actual rates of the early 1960s, were still higher than the rates of the 1960s and early 1970s. Because of the decreasing trend in population growth rates, in 1974 revised OBERS projections were issued based on Series E population projections published December, 1972 by Census.⁵ The E Series assumes a population of 263.8 million in 2000, compared to a Series C population of 306.8 million.

More recently, in October 1977, BEA issued, under contract to the Office of Water Program Operations, EPA, a set of interim revisions for states only, incorporating adjustment for the overseas population, and the significant 1970 Census undercount. These revisions are based on Series II Census population estimates,⁶ and assume a population in 2000 of 265.8 million.

A quinquennial update of the OBERS projections was issued in 1980, and was based upon Series II projections of more recent vintage. There are complete revisions for all regional classifications and industries.

¹The following discussion is partly based upon information from: U.S. Water Resources Council, 1971 OBERS Projections, Series E, Vol. 1, Concepts, Methodology and Summary Data, April 1974.

²There were 37 OBERS sectors in this report.

³Formerly Office of Business Economics.

⁴Formerly the Economic Research Service.

⁵Current Population Report P-25, #493.

⁶Current Population Reports P-25, #704, July 1977 estimates 2000 population at 260.3 million, without adjustment for 1970 undercount.

included in the 1974 Series E work.⁷

The three sets of projections issued to date may be summarized as follows:

<u>Name or Projection</u>	<u>Publication Date</u>	<u>Forecasting Group</u>	<u>2000 Population</u>
1972 OBERS, Series C	1972	BEA/USDA	306.8 m
Revised 1972 OBERS, Series E	1974	BEA/USDA	263.8 m
Interim Revisions	October 1977	BEA for EPA	265.8 m

The principal differences between the Series E and Series C projections are:

	Series C	Series E
Domestic Population (2000)	306.8 m	263.8 m
Total Personal Domestic Income (2000) million \$ 1967	2,542,849	2,154,266
Cropland Harvest (acres) 2000	309.7 m	271.9 m

These differences are the result of different population growth rate assumptions. There are additional differences:

- hours worked per year are projected to decline .35% per year in Series E, compared to .25% in Series C.
- The rate of increase in product per person-hour in the private economy is 2.9% per year in Series E, compared to 3.0% in Series C. Even so, this is an exceedingly optimistic assumption which may not be consistent with recent trends in productivity growth. In 1978, for instance, productivity growth in the private economy was about 0.8% from 1967-1977.
- Income data for 1970 and 1971 and total employment data for 1970 was included in the Series E work. This provides an additional historical base upon which to base extrapolations, and results in changes in some projections of area activity from the Series C work.

There are some additional important assumptions underlying the basic OBERS methodology. Most fundamental is that the projections are based upon long run trends and ignore cyclical fluctuations such as the 1973-74 recession. The OBERS analysts assume that nationally a 4 percent unemployment rate will prevail, though there will be regional disproportionalities -- we may regard this unemployment assumption as potentially quite optimistic.

⁷ Conversation with Ken Johnson, BEA, D.C., 1/17/79.

OBERS regional projections are based on the following assumptions:⁸

- trends toward economic area self-sufficiency in local-service industries will continue
- workers will migrate to areas of perceived economic opportunity from slow-growth or declining areas
- regional earnings per worker and income per capita will converge toward the national average
- regional employment/population ratios will move toward the national ratio.

The primary regional economic unit in the OBERS projection system is the BEA economic area, of which there are currently 183.⁹ All other regional projections, i.e., for states, water resource areas, SMSAs, are based upon divisions and combinations of portions of these economic areas.

One of the key characteristics of these economic areas is that each is self-sufficient as to labor market (place of work) and labor supply (place of residence.). There is minimal commuting across economic area boundaries.

Two types of industries are considered within each economic area. One type is the basic, or export, industries which produce goods and services most of which are exported to other economic areas in return for goods and services. The second type of industry is termed "residential" by the OBERS group, in that this group produces most of the services and some of the goods required by households, as well as local business in need of intermediate products. Residential industries include general and convenience retail and wholesale trade activities and other services difficult to transport and thus utilized in the vicinity of their production. Economic areas are considered to be nearly self-sufficient in these residential industries.

Economic area projections are carried out in somewhat different fashion for each of the following four groups:

- basic industries except agriculture and armed forces
- agriculture
- residential industries
- armed forces.

The regional distribution of armed forces within the United States is governed primarily by government decision, rather than economic forces. Assumptions are made concerning a uniform geographic reduction of these forces in future years, in some cases with significant effect upon local earnings and employment

⁸ U.S. Water Resources Council, 1972 OBERS Projections: Regional Economic Activity in the U.S., Vol. 1, p. 6, April 1974.

⁹ However, there were only 173 at the time of the 1972 Series E projections.

in those 34 economic areas in which the armed forces is a major factor in the economic activity.

The magnitude of earnings and employment in residentiary industries is assumed to be a function of regional total employment or income, and is thus closely allied to the projections for the basic industries. Agriculture earnings and employment projections represent only a slight modification of the basic industry methodology. Thus, because of the relationship of the basic industries (mining, construction, and manufacturing) to residentiary sectors, as well as the similarity of the basic industry and agriculture projection techniques, a discussion of the methodology for the basic industries is outlined below.

Shift-Share Analysis

Basic industries are projected using a variation of shift-share analysis. The shift-share technique includes a proportional growth element, as well as a differential growth element between an economic area and the nation for each industry or income component, such as earnings. Thus:

$$E_{ij}^t = (E_{io}^t/E_{io}^x) E_{ij}^x + C_{ij}^{x-t}$$

where i and j refer to the i th industry and the j th region; o refers to the summation of regions, i.e., the nation; t and x refer to the projected time point (e.g., 2000) and the base point (e.g., 1971) respectively; and C_{ij}^{x-t} refers to the difference between the national growth rate and the regional level actually attained by the industry over the same period.

The first term on the right-hand side of the equation assumes that industry i in region j will have a rate of growth equal to that of all industry i in the nation (proportional growth). The second right-hand term (C_{ij}) is the shift-share, or regional share, which measures the difference between the attained level of the left-hand side (E_{ij}), and the proportional growth of the first term. This term may be either positive or negative, depending upon whether it represents a regional comparative advantage (the region is growing faster than the rest of the nation, insofar as the industry is concerned) or a comparative disadvantage (relatively slower growth).

Numerous approaches have been taken over the past 20 years to the projection of the C_{ij} term. Each of these approaches presumably incorporates the causal economic factors associated with the regional share. Nevertheless, there is yet considerable uncertainty about the causal factors and the appropriate independent variables, and the OBERS analysts chose a simpler approach to projecting the shift-share (C_{ij}).

For each industry, a curve was fitted to each region's percent of total national income and employment, respectively, for all available years. This curve was extended to provide the region's expected percentage of earnings and employment in a given industry in the various target years. A least squares regression line fitted to the logarithm of the percentage shares converted the data to a ratio scale so that the historical growth rate and

the projected rate could be compared by analyzing the comparative slopes of the historical and extended portion of the trend line.

In addition, considerable expert review was carried out on the projections, for example to detect discrepancies between the separate earnings or employment trends, or to reflect additional knowledge about the supply of resources upon which a particular industry is dependent. Such discrepancies were reconciled, often by experts in a particular BEA economic area, and the regional percentages were normalized and applied to previously projected national totals to yield earnings and employment projections for 173 economic areas.

The entire technique assumes that "regional comparative advantage or disadvantage for an industry is reflected in the trend of the changing contribution of a given region to the U.S. total of that industry, and that the comparative advantage or disadvantage that underlies a region's changing position will continue throughout the projected time period, though not necessarily in constant degree, unless altered by some event or force."¹ The analysis of the projections by experts attempts to take account of such forces by modifying the mathematically projected value for a region.

OBERS uses the BEA economic area as its basic economic unit, and creates other geographic classifications as either aggregations or disaggregations of these areas. Fortunately, BEA economic areas are defined along county lines. The result is that the index value for an industry in a county for a given projection year may be derived by determining the percentage of national activity in that industry accounted for by the BEA area of which the county is a part. These county shares may then be aggregated in weighted fashion.

¹U.S. Water Resources Council, op.cit., p. 25.

APPENDIX I.G: Alternative Formulation of the Baseline Projection

Impact assessment methodologies typically take one of two approaches to baseline projection:

- (1) projections of population and economic activity both with and without the project are produced. The effects of the project represent the simple differences in activity between the two projections.
- (2) A projection of economic activity without the project is produced. Then the marginal effects of the project are analyzed. Total future economic activity in the impact area with the presence of the project is the sum of the two analyses.

In fact, the first procedure above implies that the marginal effects of the project have been estimated in order to produce a new baseline projection with the project.

Alternative Concept

Many projects - even those of substantial size - can be accommodated within assumed patterns of baseline growth in economic activity. (See Figure G-1 and G-2). This baseline growth projection (B) already presupposes additional industrial, population, and residential activity for all of which the jurisdictions in the impact area may have planned accordingly:

Case 1 - Assume that facility A commences operations in the impact area. The economic activity attributable to the facility (AZ, Figure G-1) can be accommodated within existing local and regional growth plans and baseline projections (BZ).

Case 2 - Assume that Facility C commences operations in the impact area (CZ, Figure G-2). The economic activity attributable to this project is so large (CZ) that it cannot be accommodated within existing plans for baseline growth (BZ). Serious problems will arise at least from that amount of activity (CB) in excess of local projections. This case is represented by the boomtown effects of a large new source in a small community.

The purpose of the techniques in this manual is to allow the user to ascertain the effects solely attributable to the project (CZ or AZ), i.e., the marginal effects of the project. Given the alternative formulation of

the baseline projection outlined you could evaluate whether these effects could or could not be accommodated within existing baseline projections and growth plans, the assumption being that the baseline projection implicitly accounts for effects issuing from the probable location of facilities similar to the facility.

This alternative was rejected in writing this manual because it was considered not acceptable to rely on local planning objectives to determine whether identified impacts are acceptable. The approach we have taken in this manual of 1) baseline projection without projection, plus (2) marginal effects of project explicitly assumes that the baseline projection does not anticipate the effects of the facility.

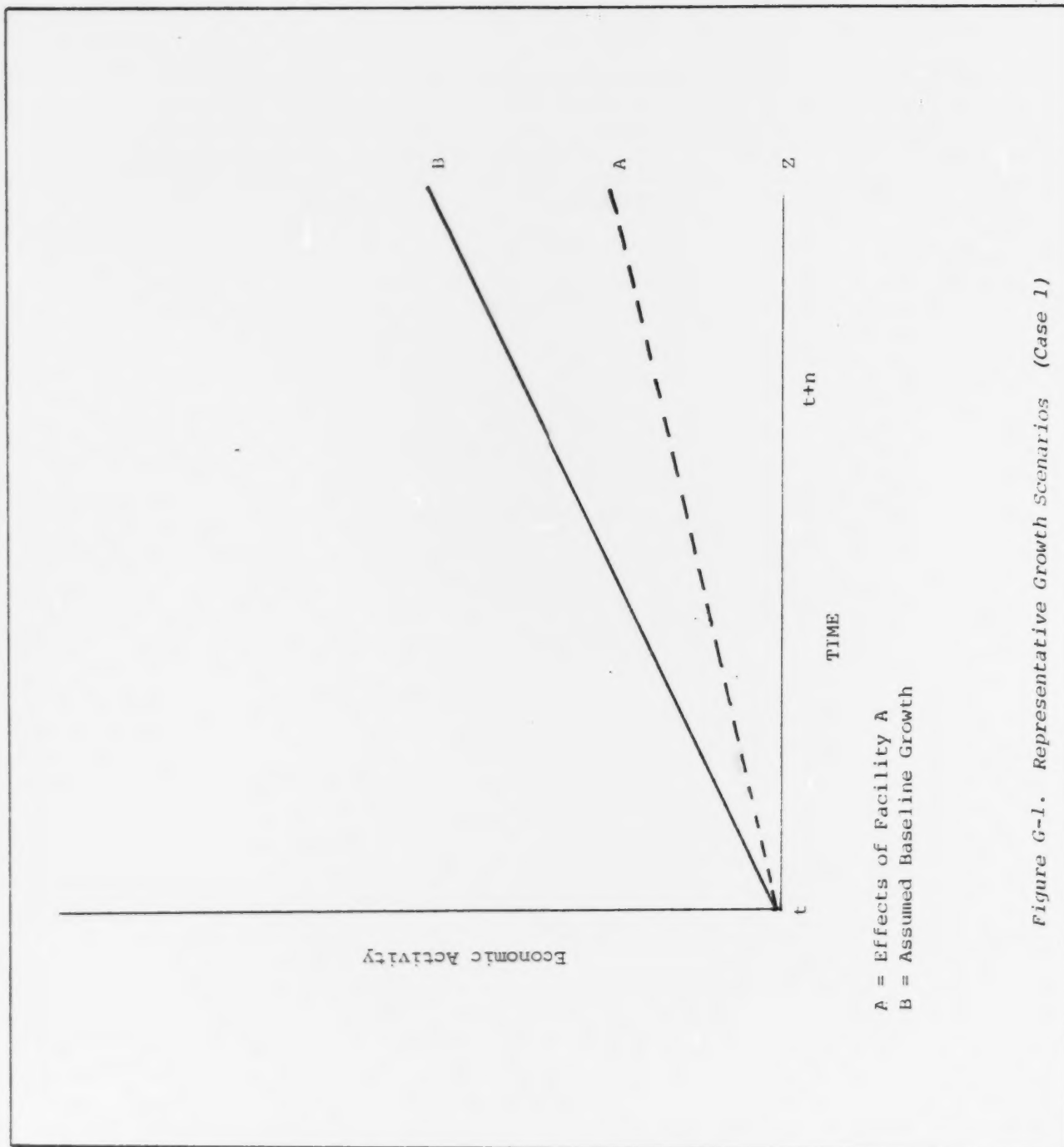


Figure G-1. Representative Growth Scenarios (Case 1)

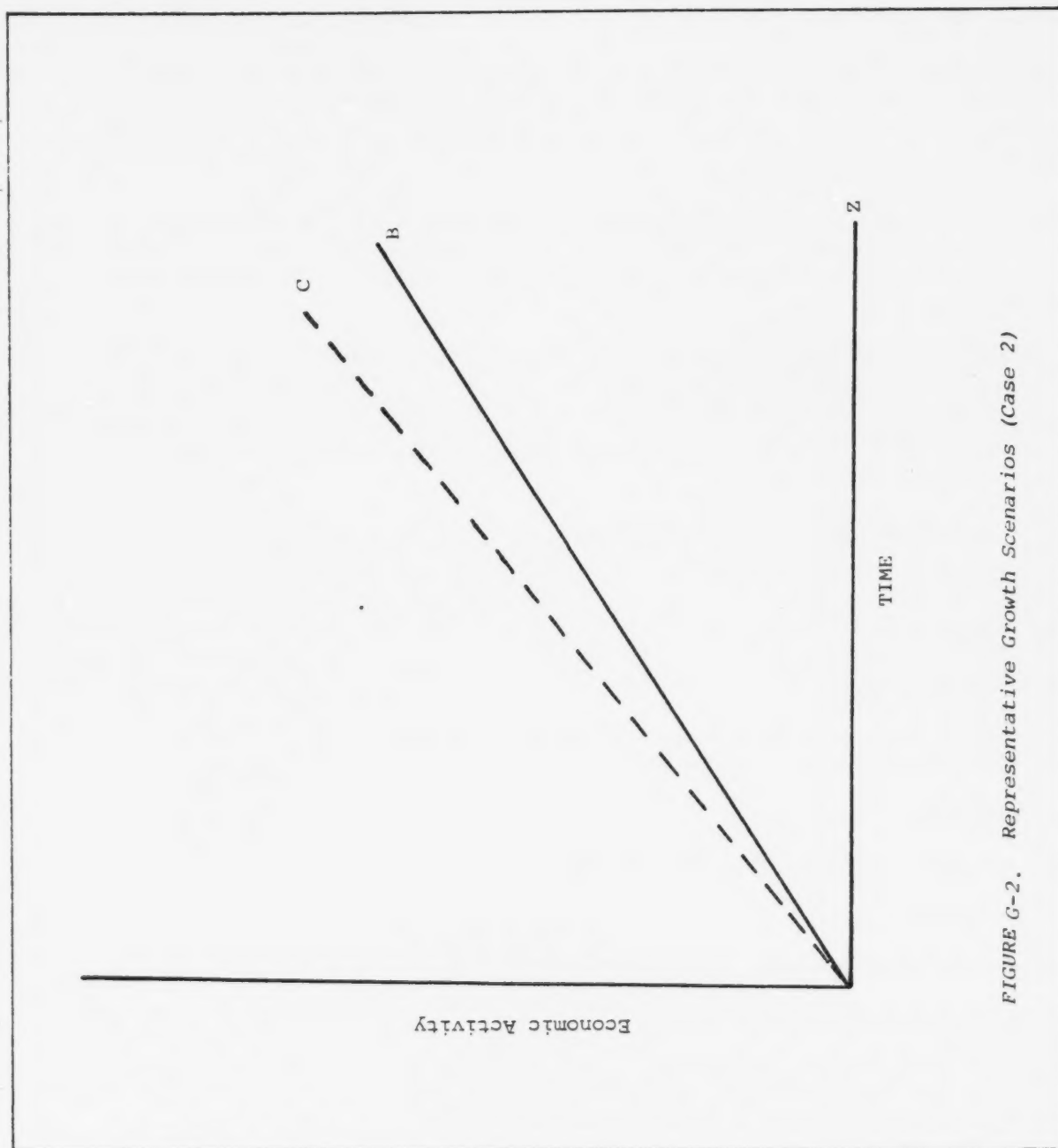


FIGURE G-2. Representative Growth Scenarios (Case 2)

APPENDIX I.H: Explanation of Standard Industrial Classification System

The user manual and Appendix I.B. refer occasionally to two-, three-, and four-digit SIC industries. This appendix explains the meaning of this reference.

The Standard Industrial Classification (SIC) Manual was originally developed by the Office of Management and Budget "to promote the comparability of statistics describing various facets of the economy of the nation."* OMB's responsibility has since been assumed by the Office of Federal Statistical Policy and Standards in the Department of Commerce.

The SIC system classifies industries in accordance with the composition and structure of their activity, and covers all economic activities. Periodically, the SIC manual is revised to reflect the changing industrial composition of the economy.

The SIC is widely used by researchers who wish to compare economic activity over time. Similarly, a number of government and private agencies collect and organize data in a form which corresponds to SIC classifications. The SIC is structured so that a one-digit division is the least disaggregated, and a four-digit industry is an extremely specific activity. Consequently, there are twelve one-digit SIC classes:

- agriculture, forestry and fisheries
- mining
- construction
- manufacturing
- transportation, communications, electric, gas and sanitary services
- wholesale trade
- finance, insurance, and real estate
- services
- public administration
- nonclassifiable establishments

and hundreds of four-digit industries. Data are generally more widely available for the less disaggregated classes of activity, and therefore most published data are for one-digit SIC divisions and two-digit industries.

*OMB. Standard Industrial Classification Manual, 1972.

APPENDIX I.J: Explanation of Figure 7, "Secondary Impacts Assessment Flowchart"

Figures J-1, J-2, and J-3* provide a progressively more detailed model of secondary impacts. Figure J-1 shows the simplest possible sequence for tracing the social and environmental effects of economic activity. A facility, because of its employment demands, induces population growth in the impact area; increased population may, in turn, require expansion of local residential housing, which results in a number of site and infrastructure impacts. Finally, expansion of residential land use has a number of environmental effects, due either to the generation of residuals (pollution), or to physical changes to land, such as impingement on sensitive areas or dislocation of wildlife habitat.

This flow diagram, although simplified, forms the model for the more complete process described in Figures J-2 and J-3. In each of these diagrams, the following conventions are used in relation to the assessment of secondary impacts:

- o Social and resource impacts are shown as inherent in changes to local land use. Social impacts include the stress of assimilation of new populations, the need to change established institutions to accommodate new social groups, and other largely unquantifiable impacts that are of greatest significance to the community. Resource impacts include water, energy, and other infrastructure requirements of new development, as well as general land allocation problems, e.g., does new residential development conflict with current zoning designations? These resource impacts are subject to fairly direct quantification and are significant primarily at the community level, although elements such as energy demand may have more regional significance.
- o Environmental impacts are shown as consequent to land reallocation or development. Once residential development has progressed, various environmental problems may occur. EPA is a concerned party in all of these areas (Blocks 7 to 11 of Figure J-3) although other Federal agencies may have a significant role in assessing these impacts.

There are some simplifications inherent in this labelling convention. For example, increased air and water pollution may significantly change the aesthetic aspects of the local environment, and thus be perceived as a social impact as well as an environmental impact. Also, sometimes resource impacts and environmental impacts are hard to distinguish: allocation of land has social significance to a community, and is thus treated as a resource problem, but part of the land being allocated may be legally sensitive, resulting in environmental impacts as well. Overall, however, the labeling conventions represent the principal categories of impacts.

*Figure J-3 is identical to Figure 7 in Chapter 4, Level C.

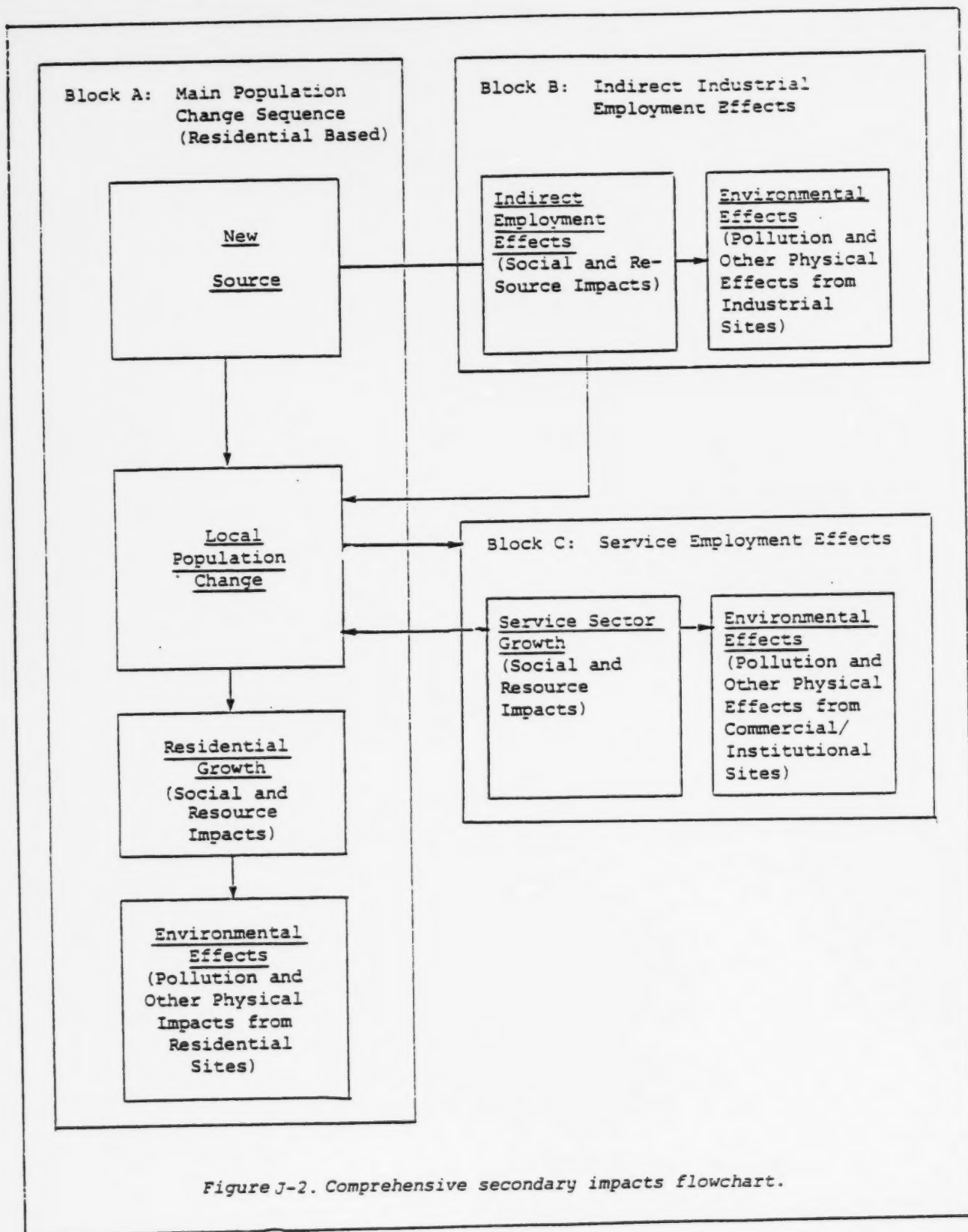


Figure J-2. Comprehensive secondary impacts flowchart.

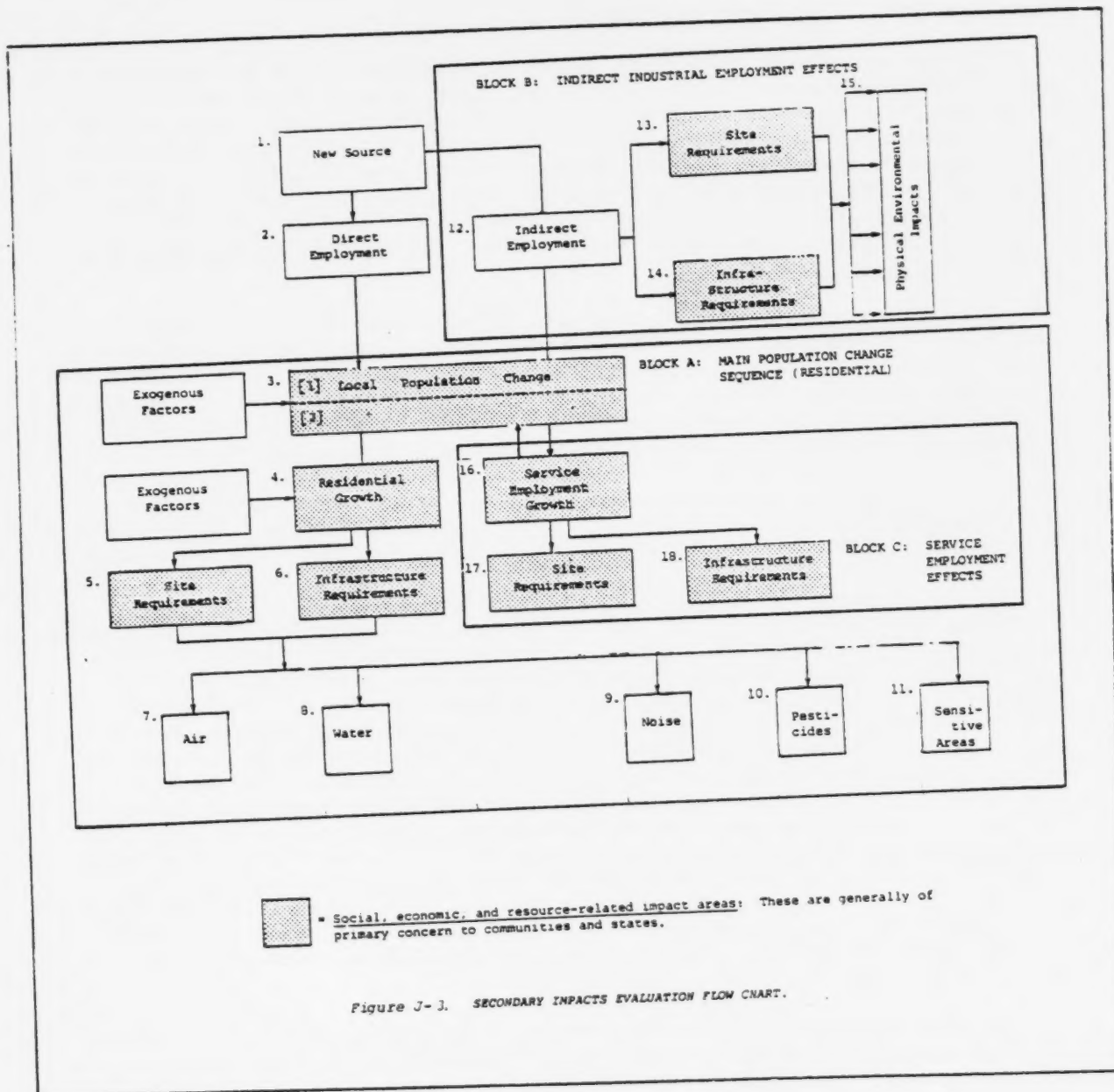


Figure J-3. SECONDARY IMPACTS EVALUATION FLOW CHART.

Figure J-1 covers only the residually-related secondary impacts of indirect and service employment induced by a facility. Figure J-2 contains additional detail for these two elements.

Indirect industrial employment (Block B) adds some social and resource impacts associated with the creation in the impact area of other facilities which supply inputs to or purchase materials from the facility. Some environmental impacts may be associated with the pollution and other physical effects at the sites of these facilities. However, the impacts of indirect industrial employment are primarily traced through the main population change sequence shown in Figure J-1. The environmental effects associated with the indirect industrial employment are considered in the user manual only in the case of a known collocating industry.

Service employment (Block C) can also affect local population levels, and thus these environmental impacts should be handled through the main population change sequence of Figure J-1. Additional service employment may translate into new commercial sites, such as shopping centers, and these would have various physical impacts of their own. As discussed in the user manual, most of the environmental impacts of commercial expansion can be either discounted as qualitatively insignificant relative to those impacts considered in the main population change sequence, or are actually accounted for elsewhere in the impact assessment process (vehicle air pollution from shopping centers, for instance, is more easily accounted for by attributing it to a residually-based auto trip.)

Figure J-3 shows a detailed version of Figure J-2, and includes some simple information on the causal sequence of secondary impacts. The main additions are: (1) the inclusion of employment as the principal intervening variable between the facility and expected local population growth; (2) the addition of exogenous factors, such as local prevailing wage rates or employment levels, that affect the amount of employment supplied by the local population, as opposed to immigrants; (3) the addition of various exogenous considerations, such as availability of developable land, that influence residential growth following population growth; and (4) the separate identification of site requirements and infrastructure requirements as intervening variables between growth in a particular land use sector and eventual physical environmental impacts. In addition, the categories of physical environmental impacts have been named. The category of sensitive areas subsumes effects on endangered species, wildlife habitat, coastal zones, and historic and archaeological preservation sites.

We have distinguished site requirements from infrastructure requirements in order to clarify the social and economic consequences of expansion of a particular land use type, and to make sure that all of the causal links between expansion of that land use and secondary physical environmental impacts are considered. In evaluating the site requirements of residential growth, collocation of industry, or commercial development, it is proper to consider zoning, relationship to existing development, taxation effects, and other site-specific factors that are of social or economic significance. It is also essential to evaluate air pollution (e.g., generation of air pollution from furnaces), water pollution (e.g., runoff, or septic tank failure), solid waste (disposal of cleared vegetation, or different solid waste generation rates for different densities or types of land use), and other physical environmental factors.

In evaluating the infrastructure requirements of land use changes, the reviewer must consider the cost of providing municipal services (e.g., sewerage, roads, water, schools, fire protection, police), as well as the environmental effects associated with various classes of infrastructure (e.g., runoff from roads, or additional loads on treatment plants for sewered communities.)

The user manual developed in this contract discusses the methodological issues associated with individual sections of the Figure J-3 flowchart, and proposes specific analytic procedures for each section. These procedures are incorporated into a three-level assessment and screening framework which provides, depending upon the potential for secondary impacts, an increasingly detailed environmental review.

Figures J-2 and J-3 indicate why secondary impacts are important, and why the assessment of them is so complex. Residential growth attributable to a facility can have a fundamental effect on land use patterns in the community, leading to unanticipated secondary physical effects. In addition, the new population associated with this residential growth may exceed the capacity of available infrastructure, leading again to dramatic physical effects as well as a reduction in the quality-of-life.

APPENDIX II.A: INFRASTRUCTURE STANDARDS

The standards presented in this section are extracted primarily from:

- Appendix A of the Economic/Demographic Assessment Manual, prepared by Mountain West Research (1), and
- Urban Planning and Design Criteria, by Lee Koppelman and Joseph DeChiara (11)

The standards in the first source were compiled by the Real Estate Research Corporation for Argonne National Laboratory⁽²⁾ and for the U.S. Department of Housing and Urban Development. We emphasize that these standards are highly generalized. You should make every effort to determine applicable state and local standards. The guidelines presented here are relevant particularly in revealing types of facilities and infrastructure that should be considered, and in estimating orders of magnitude for adequate service standards.

The standards presented in the tables consider:

- water supply and treatment
- waste water treatment
- solid waste generation and disposal
- police protection
- fire protection
- health care facilities
- educational facilities
- recreational facilities
- libraries
- commercial facilities
- roads and highways.

For some categories, we have included at least two sets of recommended standards, which can be used to define a range. In addition, for certain categories a simple standard is provided, as well as more detailed standards which correspond to specific dwelling unit densities, or types of establishments, or other characteristics.

Water Supply & Treatment

Surface water generally requires treatment, so treatment capacity is the limiting factor for water supply. If groundwater is the supply source and only chlorination or other minimal treatment is practiced, it is the capability of the source itself which limits water supply.

Table II-1 gives average per capita water usage broken down by type of use. Peak usage is normally assumed to be three times average use. Based on these consumption figures, the water supply standard is .20 acre-feet per person per year. If the water comes from a stream or well, 1600 gallons per day per connection represents adequate stream flow.

Table II-2 provides information on total daily water requirements per 100 acres of residential development, assuming different population densities. For various types of activity, average water use in gallons per day is shown in Table II-3.

Water treatment plants should be designed to process 115% of the peak water usage of the service population. Table II-4 provides information on the amount and size of pipe for adequate water distribution, assuming different housing densities.

(This section is based on data provided by (2), (4), (5), (6), and (11)).

Wastewater Treatment

In small isolated communities and rural areas, wastewater treatment plants are often unnecessary as individual septic tanks are adequate to treat water. For such a system to be feasible, the soils must be suitable and the septic tanks must be properly maintained. When these criteria are not met, or when the area is densely populated, a central wastewater treatment system should be built. Where land is readily available and inexpensive in small communities, a secondary lagoon or series of lagoons may be adequate. An average lagoon size is 10 acres per 1,000 people.

For larger communities, secondary or tertiary treatment may be needed. Table II-5 displays sewage generation rates for commercial and public establishments. A capacity of one million GPD is considered minimum for a secondary or tertiary sewage treatment plant, based on a peak of 168 GPCD. The minimum number of employees required to operate such a plant in a small community is 6.5 persons, while standard employment for a plant in a community of 30,000 to 100,000 is 4.5 to 16 persons. Table II-6 shows the necessary length and type of pipe required for various housing types.

(This section is based on information from (2), (6), and (7)).

Solid Waste Disposal

Although standards vary, most states require sanitary landfill sites for all communities. Several communities within a region may share a landfill site, depending on community size. On the assumptions that 4 to 5 pounds of waste per capita is generated daily, that the waste is compacted, that the fill depth is seven feet, and that 2/3 of the site is covered by solid waste, .21 acres maximum per 1,000 persons is needed each year for sanitary landfill.

You may wish to calculate solid waste generation on a household basis. A general assumption about these rates is:

- first adult in household - 6.5 pounds
- succeeding adults - 2.5 pounds each
- children - 1.5 pounds each.

Table II-7 details the vehicle use and employment necessary to collect solid waste. The increased efficiency of collection vehicles in larger communities reveals that it may be more practical for residents in smaller communities to haul their own garbage to the landfill site.

(This section is based on information from (2) and (6)).

Police Protection

The standard number of policemen and patrol cars per 1,000 people vary with community size. For smaller communities, 1.4 to 3 officers per thousand is sufficient, while larger communities require a higher ratio. Depending on the needs of the area and the number of shifts operated, patrol cars may be allocated to patrolmen ranging from a one-to-one basis to one-to-three basis.

One central police station is generally adequate for a town with a population of less than 30,000, while larger towns may require branch stations. Approximately 200 square feet of office space is needed for each patrolman. The need for a central dispatcher arises in towns with a population of 5,000 or greater.

(This section is based on information from (2) and (6)).

Fire Protection

The National Board of Fire Underwriters sets specific standards for communities of 30,000 persons or more. Required fire flow for a community is computed with detailed information on the site and structural characteristics of the communities' buildings. A general rule of thumb for fire flow requirements, however, is presented in Table II-8. The size of each station should be a minimum of 5,000 square feet and serve an area with a radius of

two to six miles. Two pumpers, a staff car, and an ambulance are basic equipment for towns with a population of less than 30,000 people. Volunteer firemen are sufficient for towns of fewer than 10,000 people, provided the standard of 20 volunteer firemen are available for the operation of each pumper. For larger communities, two full time firemen per 1,000 dwellings is appropriate. For major cities, the requirement increases to five firemen per thousand dwellings.

(This section is based on information from (2), (6), (8), and (9)).

Health Care Facilities

A recommended minimum for health care professionals is one doctor and .5 dentists per 1,000 people. In rural areas, general practioners will be most common, while specialists will most likely practice at regional hospitals. The following formulas are used to calculate hospital bed needs:

- (1) Current use rate =
$$\text{Patient days per year} \div \text{current population}$$
- (2) Average bed need per day =
$$(\text{Current use rate} \times \text{projected population}) \div 365$$
- (3) Bed Need =
$$\text{Average bed need per day} \div .80 \text{ (assumed occupancy rate)}$$

The required space for all services provided in a hospital is shown in Table II-9.

(This section is based on information from (2), (6), and (9)).

Recreation

Table II-10 provides standards for a variety of recreational activities and recreational areas, including information on space, size, and service radius. Tables II-11 and II-12, which rely on a different source, provide a slightly different estimate of adequacy and service characteristics. The two sources together define a suitable range for recreation standards.

Maintenance for playgrounds and parks depends largely on the size of the facilities and the climate. In areas where cold winters render parks inoperative, the maintenance is less than for those parks in year-round use. Table II-13 shows approximate maintenance needs for communities of various sizes.

(This section is based on information from (2), (6), and (11)).

Libraries

A general description of library characteristics is given in Figure II-14, with standards for number of volumes given in the next figure. The minimum book stock of any library, as an independent unit, should be 6,000 volumes

regardless of population served.

The Public Library Association approves the standards in Table II-16 for small libraries. In addition, it is estimated that seating for 20 persons is necessary for libraries serving less than 3,000 people and five additional seats are required per each successive 1,000 people served. Table II-17 and Table II-18 set guidelines for library periodical collections and operating hours. A minimum of one professional is necessary for each 1,500 persons served, as well as one non-professional for every four professionals. Parking needs are estimated as one space for every 2 workers and one space for every 4 seats in rooms of public assembly.

(This section is based on information from (2), (6), (10) and (11)).

Schools

Table II-19 lists pupil generation rates by type of dwelling unit. You may use these if you have specific information about the typology of new dwelling units in the impact area.

Tables II-20 to II-23 provide data concerning the general requirements of nursery, elementary, junior high, and senior high schools, respectively. In smaller communities, some of these requirements, particularly service radius and minimum pupil size, will have to be relaxed.

A classroom or its equivalent should be available for each teacher in elementary school. Ninety (90) square feet per pupil is recommended - this includes all space, including teaching and administrative, library, recreational areas, etc. Administrative staff size (principals, librarians, counselors) is dependent on pupil size. The U.S. Department of Health and Human Services suggests one staff member for every eight teachers. In small schools, administrative staff may consist only of a principal or a half-time principal with teaching responsibilities.

Recommended minimum square footage per pupil for secondary schools is 150 square feet. Again, the standards shown are not feasible for smaller communities.

Secondary schools often provide extensive recreational facilities for students. In small communities, municipal facilities can be built at the school so that the town and the school district can share both the costs and benefits of the facilities. The same ratio of staff to teachers applies as in elementary schools, with a typical breakdown as shown in Table II-24.

(This section is based on information from (2), (6), (11) and (12)).

Roads and Highways

Residential growth attributable to the new source may result in a need for new roads or highways. The general features of these facilities are

provided in Table II-25, as a guide to the potential impacts of their construction.

(This section is based on information from (11)).

Shopping Centers

The development of a new shopping center entails considerable space requirements, as outlined in Table II-26. New residential growth does not imply shopping center growth, if existing facilities are adequate -- the guidelines in the table can be used to judge this adequacy.

(This section is based on information from (11)).

TABLE II-1
NORMAL WATER CONSUMPTION

	<u>Average</u>	<u>Normal Range</u>
Domestic use	30 gpd	15 - 70 gpd
Commercial, industrial use	65 gpd	10 - 100 gpd
Public use	10 gpd	5 - 20 gpd
Miscellaneous use	<u>25 gpd</u>	<u>10 - 40 gpd</u>
TOTAL	150 gpd	40 - 230 gpd

Source: Fair, Geyer, and Okun, Water Supply and Wastewater Removal, (New York, 1966), as cited in Argonne National Laboratory, A Framework for Projecting Employment and Population Changes Accompanying Energy Development, Phase II. August 1976, p. 48.

TABLE II-2

REQUIRED WATER SUPPLY FOR DOMESTIC USE & FIRE FLOW

Population Density(1) (per acre)	Average Daily (gpcd)	Water Use: Acre-Ft. (2) per 1000 Population	Total Daily Water Requirements per 100 Acres of Residential Development			
			Average Day 1000 gal. Ac.Ft.		Max. Day 1000 gal. Ac.Ft. (3)	
Less than 1 d.u.	300	.92	57	.18	171	.54
1 - 2.9 d.u.	225	.69	171	.53	513	1.59
3 - 4.9 d.u.	190	.58	253	.78	759	2.34
5 - 15 d.u.	150	.46	455	1.40	1365	4.20
Over 15 d.u.	125	.38	950	2.92	2850	8.76

(1) Assumes 3.8 persons per dwelling unit (d.u.)

(2) One acre-foot equals 325,830 gallons

(3) Equals three times average daily consumption

Source: Joseph DeChiara and Lee Koppelman. Urban Planning and Design Criteria. 2nd Edition, New York, Van Nostrand & Reinhold, 1975.

TABLE II-3

AVERAGE WATER USE BY TYPE OF ESTABLISHMENT

Type of Establishments	Gallons per Day
Airports (per passenger)	3-5
Apartments, multiple family (per resident)	60
Bathhouses (per bather)	10
Camps:	
Construction, semipermanent (per worker)	50
Day with no meals served (per camper)	15
Luxury (per camper)	100-150
Resorts, day and night, with limited plumbing (per camper)	50
Tourist with central bath and toilet facilities (per person)	35
Cottages with seasonal occupancy (per resident)	50
Courts, tourist with individual bath units (per person)	50
Clubs:	
Country (per resident member)	100
Country (per nonresident member present)	25
Dwellings:	
Boardinghouses (per boarder)	50
Additional kitchen requirements for nonresident boarder	10
Luxury (per person)	100-150
Multiple family apartments (per resident)	40
Rooming houses (per resident)	60
Single family (per resident)	50-75
Estates (per resident)	100-150
Hotel with private baths (2 persons per room)	60
Hotels without private baths (per person)	50
Institutions other than hospitals (per person)	75-125
Hospitals (per bed)	250-400
Laundries, self-serviced (gallons per washing; i.e., per customer)	50

Table II-3 (cont.)

Type of Establishment	Gallons per day
Livestock (per animal):	
Cattle (drinking)	12
Dairy (drinking and servicing)	35
Goat (drinking)	2
Hog (drinking)	4
Horse (drinking)	12
Mule (drinking)	12
Sheep (drinking)	2
Steer (drinking)	12
Motels with bath, toilet, and kitchen facilities (per bed space)	50
With bed and toilet (per bed space)	40
Parks:	
Overnight with flush toilets (per camper)	25
Trailers with individual baths units (per camper)	50
Picnic:	
With bath houses, showers, and flush toilets (per picnicker)	20
With toilet facilities only (gallons per picnicker)	10
Poultry:	
Chickens (per 100)	5-10
Turkeys (per 100)	10-18
Restaurants with toilet facilities (per patron)	7-10
Without toilet facilities (per patron)	2½-3
With bars and cocktail lounge (additional quantity per patron)	2
Schools:	
Boarding (per pupil)	75-100
Day with cafeteria, gymnasiums, and showers (per pupil)	25
Day with cafeteria but no gymnasiums or showers (per pupil)	20
Day without cafeteria, gymnasiums, or showers (per pupil)	15
Service stations (per vehicle)	10
Stores (per toilet room)	400
Swimming pools (per swimmer)	10

TABLE II-3 (cont.)

Type of Establishments	Gallons per day
Theaters:	
Drive-in (per car space)	5
Movie (per auditorium seat)	5
Workers:	
Construction (per person per shift)	50
Day (school or offices per person per shift)	15

Source: Environmental Health Practice in Recreational Areas, Public Health Service, U.S. Department of Health, Education & Welfare.

TABLE II-4

BASIC WATER DISTRIBUTION STANDARDS BY HOUSING TYPE
(per 1,000 Dwelling Units)

<u>SF₁</u>	<u>SF₂</u>	<u>SF₃</u>
47,500' of total pipe comprised of:	52,000 of total pipe comprised of:	Individuals Wells
35% - 6"	35% - 6"	
35% - 10"	35% - 10"	
20% - 15"	20% - 15"	
10% - 24"	10% - 24"	

<u>SF₄</u>	<u>Townhouse</u>	<u>Walkups</u>	<u>Mid-Rise</u>
Individual Wells	23,000' of total pipe comprised of:	15,500 of total pipe comprised of:	8,000 of total pipe comprised of:
	35% - 6"	35% - 8"	35% - 8"
	35% - 10"	35% - 12"	35% - 12"
	20% - 15"	20% - 15"	20% - 15"
	10% - 24"	10% - 24"	10% - 24"

Key: SF₁ = 65% conventional single-family at 3 units per acre, 35% single-family clustered at 5 units per acre. (Overall density - 3.7 units per acre).

SF₂ = 90% conventional single family at 3 units per acre, 10% single-family clustered at 5 units per acre. (Overall density - 3.2 units per acre).

SF₃ = single-family (conventional) at 0.5 units per acre.

SF₄ = single-family (clustered) at 1.0 unit per acre.

TH = Townhouses at 10 units per acre.

WU = Walkups at 15 units per acre.

MR = Mid-rises at 30 units per acre.

Source: Real Estate Research Corporation as cited in: Argonne National Laboratory, A Framework for Projecting Employment and Population Changes Accompanying Energy Development, Phase II, August 1976, prepared for the U.S. Energy Research Development Administration, p. 44.

TABLE II-5

SEWAGE GENERATION RATES FOR
COMMERCIAL AND PUBLIC ESTABLISHMENTS

	Gallons Per Person Per Day
Hotels	50 to 150
Motels	50 to 125
Restaurants (toilet and kitchen wastes per patron)	7 to 10
Additional for bars and cocktail lounges	2
Tourist courts with individual bath units	50 to 120
Luxury camps	100 to 150
Camps	25 to 40
Day camps (no meals)	15
Day schools (with cafeterias, showers)	15 to 25
Boarding schools	75 to 100
Day workers at schools or offices	12 to 35
Hospitals	150 to 250 or more
Other institutions	75 to 125
Factory workers (per shift)	15 to 35
Picnic parks (with bathhouses and showers)	10
Swimming pools and bathhouses	10
Drive-in theaters (per car space)	5 to 10
Theaters (per seat)	5
Places of assembly	3 to 10
Airports (per passenger)	3 to 5
Self-service laundries (per wash)	50
Stores (per toilet room)	400
Service stations (per vehicle served)	10
	Gallons Per Day 1,000 sq. ft.
Hotels	600 to 1,100
Office buildings	100 to 500
Department stores	100 to 400
Apartment hotels	200 to 400
	Gallons Per Day Per Acre
Light industry	14,000
Hotels, stores, and office buildings	60,000
Markets, warehouses, wholesale establishments	15,000
High-cost residential	7,500
Medium-cost residential	8,000
Low-cost residential	16,000

Source: Sigurd Grave, Urban Planning Aspects of Water Pollution Control, (Columbia University Press, New York 1969), as cited in Argonne National Laboratory, A Framework for Projecting Employment and Population Changes Accompanying Energy Development, Phase II, August 1976, prepared for the U.S. Energy Research Development Administration, p. 49.

TABLE II-6

BASIC SEWAGE STANDARDS BY HOUSING TYPE^a
 (Per 1,000 Dwelling Units)

<u>SF₁</u>	<u>SF₂</u>	<u>SF₃</u>	<u>SF₄</u>
47,500' of total pipe comprised of:	52,000' of total pipe comprised of:	Septic Tank	Septic Tank
70% - 8"	70% - 8"		
20% - 15"	20% - 15"		
10% - 30"	10% - 30"		
<u>Townhouse</u>	<u>Walkup</u>	<u>Mid-Rise</u>	
23,000' of total pipe comprised of:	13,500' of total pipe comprised of:	8,000' of total pipe comprised of:	
70% - 8"	70% - 8"	70% - 8"	
20% - 15"	20% - 15"	20% - 15"	
10% - 30"	10% - 30"	10% - 30"	

^aSee Table II-4 for key to symbols.

Source: Real Estate Research Corporation as cited in: Argonne National Laboratory, A Framework for Projecting Employment and Population Changes Accompanying Energy Development, Phase II, August 1976, prepared for the U.S. Energy Research Development Administration, p. 46.

TABLE II-7

SOLID WASTE SERVICE STANDARDS

	Moderate Urban (30,000 to 100,000)	Small Urban (10,000 to 30,000)	Rural Balance (less than 10,000)
Suburb or Fringe	1 collection vehicle serves about 3,200 dwelling units: 1,000 units=31% of 1 truck; 1,938 man-hours per year per 1,000 dwelling units	1 collection vehicles serves about 3,100 dwelling units: 1,000 units=32% of 1 truck; 2,018 man-hours per year per 1,000 dwelling units	1 collection vehicle serves about 3,050 dwelling units: 1,000 units=33% of 1 truck; 2,040 man-hours per year per 1,000 dwelling units
Independent Outlying Community	NA	1 collection vehicle serves about 3,050 dwelling units: 1,000 units=33% of 1 truck; 2,040 man-hours per year per 1,000 dwelling units	1 collection vehicle serves about 2,900 dwelling units: 1,000 units=35% of 1 truck; 2,148 man-hours per year per 1,000 dwelling units
Dependent Outlying Community	NA	1 collection vehicle serves about 3,050 dwelling units: 1,000 units=33% of 1 truck; 2,040 man-hours per year per 1,000 dwelling units	1 collection vehicle serves about 2,900 dwelling units: 1,000 units=35% of 1 truck; 2,148 man-hours per year per 1,000 dwelling units
Non-Urban	NA	NA	1 collection vehicle serves about 1,800 dwelling units: 1,000 unit=55% of 1 truck; 3,475 man-hours per year per 1,000 dwelling units

NA = Not Applicable

Source: Real Estate Research Corporation as cited in: Argonne National Laboratory, A Framework for Projecting Employment and Population Changes Accompanying Energy Development, Phase II, August 1976, prepared for the U.S. Energy Research Development Administration, p. 53.

TABLE II-8
REQUIRED FIRE FLOW, BY POPULATION

<u>Population</u>	<u>gmp</u>	<u>mgd</u>	<u>Duration hours</u>
1,000	1,000	1.44	4
1,500	1,250	1.80	5
2,000	1,500	2.16	6
3,000	1,750	2.52	7
4,000	2,000	2.88	8
5,000	2,250	3.24	9
6,000	2,500	3.60	10
10,000	3,000	4.32	10
13,000	3,500	5.04	10
17,000	4,000	5.76	10
22,000	4,500	6.48	10
27,000	5,000	7.20	10
33,000	5,500	7.92	10
40,000	6,000	8.64	10
55,000	7,000	10.08	10
75,000	8,000	11.52	10
95,000	9,000	12.96	10
120,000	10,000	14.40	10
150,000	11,000	15.84	10
200,000	12,000	17.28	10

Over 2,000 population, 12,000 gpm, with 2,000 to 8,000 gpm additional for a second fire, for a 10-hour duration.

mgd = millions of gallons per day.

Source: De Chiara, Joseph, and Koppelman, Lee. op.cit.
New York, New York: Van Nostrand & Reinhold Co., 1978.

TABLE II-9

SPACE CRITERIA FOR HOSPITAL EVALUATION
(In Gross Square Feet per Bed)

<u>Department</u>	<u>100-Beds</u>	<u>200-Beds</u>	<u>300-Beds</u>	<u>400-Beds</u>
1. <u>Nursing Services</u>	362-439	356-432	351-427	355-441
a. Bed Units	290-350	290-350	290-350	300-370
b. Operating Suite	44- 54	41- 51	39- 49	36- 46
c. Delivery Suite	18- 20	16- 18	14- 16	12- 14
d. Emergency Suite	10- 15	9- 13	8- 12	7- 11
2. <u>Professional Services</u>	60- 81	57- 74	53- 72	48- 67
a. Laboratories	22- 28	21- 27	20- 26	20- 26
b. X-Ray	24- 32	24- 30	22- 28	21- 27
c. Physical Therapy	8- 12	7- 10	8- 12	7-11
d. Pharmacy	6- 9	6- 8	5- 8	4- 7
3. <u>Supportive Services</u>	164-199	151-183	140-168	130-157
a. Food Service	45- 50	42- 47	39- 44	36- 41
b. Housekeeping	4- 7	4- 5	3- 4	2- 3
c. Laundry	15- 17	12- 14	12- 14	11- 13
d. Sterile Supply	10- 13	9- 12	8- 11	7- 10
e. Central Stores	25- 35	25- 35	24- 32	23- 30
f. Employee Facilities	13- 17	12- 15	10- 12	9- 11
g. Shops and Mechanicals	52- 60	47- 55	44- 51	42- 49
4. <u>Administrative Services</u>	60- 70	55- 65	52- 63	48- 59
a. Offices	34- 39	31- 36	30- 36	29- 35
b. Medical Records	10- 11	10- 11	9- 10	8- 9
c. Public Space	8- 10	7- 9	7- 9	6- 8
d. Volunteers' Space	8- 10	7- 9	6- 8	5- 7
TOTAL HOSPITAL	646-789	620-755	598-732	585-728
5. <u>Outpatient Suite</u>	0- 40	0- 45	0- 50	0- 60

Source: Space Criteria for Hospital Evaluation, Hospital Planning Council of Metropolitan Chicago, Chicago Hospital Planning Council, 1965, as cited in Argonne National Laboratory, A Framework for Projecting Employment and Population Changes Accompanying Energy Development, Phase II, August 1976, prepared for the U.S. Energy Research Development Administration, p. 59.

TABLE 11-10

STANDARDS FOR RECREATIONAL ACTIVITIES

A. Standards for Recreational Activities		Type of Recreational Activity		Space requirements for Activity per Population	Approximate size of Space Required for Activity	Recreational Area wherein Activity May Be Located
Active Recreation						
1. Children's Play Area (with equipment)				0.5 acre/1,000 pop.	1 acre	Playgrounds-Neighborhood Parks, Community Parks, School Playgrounds
2. Field Play Areas for Young Children				1.5 acres/1,000 pop.	3 acres	Playgrounds-Neighborhood Parks, Community Parks
3. Older Children-Adult Field Sports Activities				1.5 acres/1,000 pop.	15 acres	Playfields-Community Park District Park
4. Tennis, Outdoor Basketball, Other Outdoor Sports				1.0 acres/5,000 pop.	2 acres	Playfields-Community Park
5. Swimming				1 outdoor pool/25,000 pop.	2 acres	Playfields-Community Park
6. Major Boating Activities				100 acres/50,000 pop.	2 acres	District Park-Regional Park or Reservation
7. Hiking-Camping-Horseback Riding-Nature Study				10 acres/1,000 pop.	100 acres and more than 1,000 acres	Large District Park-Regional Park
8. Golfing				1 18-hole course per 50,000 pop.	120 acres	Community Park-District Park
Passive Recreation						
1. Picnicking				4 acres/1,000 pop.	Varies	All parks
2. Passive Water Sports				1 Lake or Lagoon per 25,000 pop.	20 acre water area	Community Park
3. Fishing-Boating-Canoing				1 acre/1,000 pop.	100 acres	Special Regional Reservation Large District Park or Special Facility
Other						
1. Parking at Recreational Areas				1 acre/1,000 pop.	Varies	Playfields, Community District & Regional Parks
2. Indoor Recreation Centers				1 acre/10,000 pop.	1-2 acres	Community Parks
3. Outdoor Theatres, Band Shells				1 acre/25,000 pop.	5 acres	District Parks
B. Standards for Recreation Areas						
Type of Area		Acres per 1,000 Population	Size of Site	Depth	Width	Radius of Area Covered
Playgrounds		1.5	1 acre	2 acres	0.5 mile	0.5
Neighborhood Parks		2.0	10	5		1.5
Playfields		1.5	15	10		2.0
Community Parks		3.5	100	40		3.0
District Parks		3.0	200	100		3.0
Regional Parks and Reservations		15.0	500-1,000	Varies		10.0

TABLE II-11

MINIMUM RECREATION STANDARDS

<u>Facility</u>	<u>Ages Served</u>	<u>Acres of Space</u>	<u>Service Radius</u>	<u>One Acre Serves Total Population of:</u>
Play lot	Pre-school	1/8	1 block	800
Playground	5-14	3	1/2 mile	1,000
Neighborhood Park	All ages	2	1/2 mile	800
Playfield	Teenage and Adult	12	City (Community)	800
Community Park	All ages	30	City (Community)	250

A minimum suggested for separate playground serving small communities:

<u>Population</u>	<u>Children</u>	<u>Number of Acres</u>
2,000	450	3.25
3,000	600	4.0
4,000	800	5.0
5,000	1,000	6.0

per 50,000 persons

25 miles of hiking trails

25 miles of cycling trails

5 miles of bridle trails

Source: National Park and Recreation Association, as cited in Interim Guide for Environmental Assessment, U.S. Department of Housing & Urban Development.

TABLE II-12

RECREATION DEMAND FOR SPECIFIC TYPES OF FACILITIES

<u>Specific Activity</u>	<u>Average Population Served</u>
Swimming pool	3 percent of population at a given time with 12 square feet of water per swimmer
Golf (18-hole)	50,000
Recreation Building (1-3 acres)	20,000
Tennis courts	1 court per 2,000
Baseball	1 diamond per 6,000
Softball	1 diamond per 3,000

Source: National Park and Recreation Association, as cited in Interim Guide for Environmental Assessment, U.S. Department of Housing and Urban Development.

TABLE II-13

MAINTENANCE REQUIREMENTS FOR PARKS AND PLAYGROUNDS

<u>Community Size</u>	<u>Full-Time Workers</u> (per thousand population)	<u>Part-Time Workers</u> (per thousand population)
10,000 - 30,000	0.3 - 0.45	2-3
30,000 - 100,000	.5 - .6	2.4
> 100,000	.6 - 1.0	1.5

TYPE	AREA SERVED	POPULATION SERVED	MISCELLANEOUS
CENTRAL or MAIN	Whole City or Municipality	No Limit & Varies	Should be within a block or two of main business & shopping area & convenient to main traffic & trans- portation arteries.
BRANCH	1 to 1½ Miles	Minimum is from 25,000 to 55,000 People	Should be easily access- ible. These requirements are for cities of 100,000 people or more.
SUB-BRANCH	Detached Areas & Smaller Cities	Varies	Frequently not open every day or housed in a library- owned building. Can be in community buildings or schools or rented quarters.

Source: Koppelman and DeChiara, op. cit.

FIGURE II-14: Description of Library Characteristics

POPULATION OF LIBRARY AREA		Volumes per Capita	Maximum number of Volumes
Minimum	Maximum		
6,000	10,000	3.0	25,000
10,000	35,000	2.5	70,000
35,000	100,000	2.0	175,000
100,000	200,000	1.75	300,000
200,000	1,000,000	1.5	1,000,000
Over 1,000,000		1.0	

Source: Koppelman and De Chiara, op. cit.

FIGURE II-15: General Standards for Libraries

TABLE II-16
GUIDELINES FOR SMALL LIBRARIES

<u>Population Served</u>	<u>Size of Book Collection</u>	<u>Total Floor Space</u>
Under 2,500	10,000 volumes	2,000 square feet
2,500 - 4,999	10,000 volumes plus 3 books per capita for population over 3,500	2,500 square feet or 0.7 sq. ft. per capita, whichever is greater
5,000 - 9,999	15,000 volumes plus 2 books per capita for population over 5,000	3,500 square feet or 0.7 sq. ft. per capita, whichever is greater
10,000 - 24,999	2,000 volumes plus 2 books per capita for population over 10,000	7,000 sq. ft. or 0.7 sq. ft. per capita, whichever is greater
25,000 - 49,999	50,000 volumes plus 2 books per capita for population over 25,000	15,000 square feet or 0.6 sq. ft. per capita, whichever is greater
Source: Public Library Association. <u>Interim Standard for Small Public Libraries: Guidelines Toward Achieving the Goals of Public Library Service.</u>		

TABLE II-17
GUIDELINES FOR PERIODICAL COLLECTIONS

<u>Population</u>	<u>Number of Publications</u>	<u>Back Files Kept</u>
Less than 5,000	50 - 75	1 - 5 years
5,000 - 9,999	75 - 125	1 - 10 years
10,000 - 24,999	125 - 200	5 - 10 years
25,000 - 49,999	200 - 250	5 - 10 years
50,000 or more	250 or more	10 - 25 years

Source: Real Estate Research Corporation as cited in: Argonne National Laboratory, A Framework for Projecting Employment and Population Changes Accompanying Energy Development, Phase II, August 1976, prepared for the U.S. Energy Research Development Administration p. 76.

TABLE II-18
STANDARDS FOR LIBRARY OPERATING HOURS

<u>Population</u>	<u>Hours Open</u>
Under 5,000	20 hours per week
5,000 - 9,999	45 - 50 hours per week
10,000 - 24,999	50 - 68 hours per week
25,000 and over	68 or more per week

Source: Real Estate Research Corporation as cited in: Argonne National Laboratory, A Framework for Projecting Employment and Population Changes Accompanying Energy Development, Phase II, August 1976, prepared for the U.S. Energy Research Development Administration, p. 77.

TABLE II-19
PUPIL GENERATION RATES BY TYPE OF DWELLING

<u>Bedroom Type</u>	<u>Grade Level</u>	<u>Pupil Multiplier</u>
Garden Apartment One-Bedroom	Kindergarten	.005
	Grammar School	.024
	High School	.017
		.046
Two-Bedroom	Kindergarten	.032
	Grammar School	.250
	High School	.062
		.344
Townhouses Two-Bedroom	Kindergarten	.029
	Grammar School	.134
	High School	.057
		.220
Three-Bedroom	Kindergarten	.097
	Grammar School	.450
	High School	.108
		.655
Four-Bedroom	Kindergarten	.125
	Grammar School	.712
	High School	.189
		1.026
Highrise Studio	Kindergarten	.000
	Grammar School	.000
	High School	.000
		.000
One-Bedroom	Kindergarten	.006
	Grammar School	.006
	High School	.000
		.012

Table II-19 cont.

<u>Bedroom Type</u>	<u>Grade Level</u>	<u>Pupil Multiplier</u>
Highrise		
Two-Bedroom	Kindergarten	.021
	Grammar School	.115
	High School	.045
		.181
Single Family		
Three-bedroom	Kindergarten	.083
	Grammar School	.408
	High School	.135
		.626
Four-Bedroom	Kindergarten	.152
	Grammar School	.969
	High School	.172
		1.293

Source: Center for Urban Policy Research, Housing Development and Municipal Costs, Rutgers, N.J.: Rutgers University, 1973.

TABLE II-20

GENERAL REQUIREMENTS FOR NURSERY SCHOOLS

Assumed Family Size	3.5 persons	Area Required	4 classes - 4000 SF 6 classes - 6000 SF 8 classes - 8000 SF
Assumed Population Characteristics	60 children of Nursery School age per 1000 persons or 275-300 families		
Number of Children of Nursery School Age Per Family	.20 children	Accessory Facilities	Playlot for children's play area with equipment. Play area should be completely fenced in from other activities.
Age of Children Served	2½ to 5 years old	Radius of Area Served	1 - 2 blocks - desirable 1/8 mile - maximum
Size of Nursery School	Minimum - 4 classes (60 children) Average - 6 classes (90 children) Maximum - 8 classes (120 children)	Design Features	Nursery School should be accessible by footpath from dwelling units without crossing any streets. If street must be crossed it should be minor street
Population Served	4 classes - 1000 persons 275-300 families 6 classes - 1500 persons 425-450 families 8 classes - 2000 persons 550-600 families	General Location	Near an Elementary School or Community Center
		Accessory Parking	1 space for each 2 classes

These figures will vary for most areas. They are based on a full cross-section of the population. Population figures should be checked for local age distribution and birth trends for any specific location.

Source: Koppelman and De Chiara, op. cit.

TABLE II-21

ELEMENTARY SCHOOL GENERAL REQUIREMENTS

Assumed Family Size	3.5 persons	Area Required	Minimum school - 7-8 acres Average school - 12-14 acres Maximum school - 16-18 acres
Assumed Population Characteristics	175 children of Elementary School age per 1000 persons or 275-300 families	Accessory Facilities	playground completely equipped for a wide range of activities playground area should be completely screened from street
Number of Children of Elementary School Age Per Family	.54 children	Radius of Area Served	1/4 miles - desirable 1/2 mile - maximum
Age of Children Served	5 thru 11 years	Design Features	Elementary School should be accessible by footpath from dwelling units without crossing any streets. If street must be crossed it should be a minor street
Size of Elementary School	Minimum - 250 pupils Average - 800 pupils Maximum - 1200 pupils	General Location	Near center of residential area, near or adjacent to other community facilities
Size of Typical Class	30 - 32 pupils	Accessory Parking	One space per class plus 3 spaces
Population Served	Minimum school - 1500 persons Average School - 5000 persons Maximum school - 7000 persons		

These figures will vary for most areas. They are based on a full cross-section of the population. Population figures should be checked out for local age distribution and birth trends for any specific location.

Source: Koppelman and De Chiara, *op. cit.*

TABLE II-22

JUNIOR HIGH SCHOOL GENERAL REQUIREMENTS

Assumed Family Size	3.5 persons	Area Required	Minimum School - 18-20 acres Average School - 24-26 acres Maximum School - 30-32 acres
Assumed Population Characteristics	75 children of Junior High School age per 1000 persons or 275-300 families		
Number of Children of Jr. High School Age per Family	.22 children	Accessory Facilities	Playground completely equipped for a wide range of game activities
Age of Children Served	12 to 14 years	Radius of Area Served	1/2 mile - desirable 3/4 miles - maximum
Size of Junior High School	Minimum school - 800 pupils Average school - 1200 pupils Maximum school - 1600 pupils	Design Features	School should be away from major arterial streets; pedestrian walkways from other areas should be provided
Size of Typical Class	30-32 pupils		
Population Served	Minimum school - 10,000 persons 2,750 - 3,000 families Average school - 16,000 persons 4,500 - 5,000 families Maximum school - 20,000 persons 5,800 - 6,000 families	General Location	Located near concentration of dwelling units or near center of residential area
		Accessory Parking	One space per classroom plus six spaces

These figures will vary for most areas. They are based on a full cross-section of the population. Population figures should be checked for local age distribution and birth trends for any specific location.

Source: Koppelman and De Chiara, *op. cit.*

TABLE II-23
SENIOR HIGH SCHOOL GENERAL REQUIREMENTS

Assumed Family Size	3.5 persons	Area Required	Minimum - 32-34 acres Average - 40-42 acres Maximum - 48-50 acres
Assumed Population Characteristics	75 children of High School age per 1000 persons or 275 to 300 families		
Number of Children of High School Age Per Family	.22 children	Accessory Facilities	Playground completely equipped for a wide range of game activities
Age of Children Served	15-18 years	Radius of Area Served	3/4 mile - desirable 1 mile - maximum
Size of High School	Minimum - 1000 pupils Average - 1800 pupils Maximum - 2600 pupils	Design Features	School should be located adjacent to a park area. School should be adequately screened from noise or objectionable uses
Size of Typical Class	30-35 pupils		
Population Served	Minimum - 14,000 persons 3,800 - 4,000 families Average - 24,000 persons 6,800 - 7,000 families Maximum - 34,000 persons 9,800 - 10,000 families	General Location	School should be centrally located for easy access. Proximity to other community facilities is advantageous.
		Accessory Parking	1 space per classroom plus 16 spaces

These figures will vary for most areas. They are based on a full cross-section of the population. Population figures should be checked for local age distribution and birth trends for any specific location.

Source: Koppelman and De Chiara, *op. cit.*

TABLE II-24
SECONDARY SCHOOL STAFF

<u>Function</u>	<u>Percent of Staff</u>
Principals and Assistants	37%
Consultants and Supervisors	14%
Librarians	16%
Counselors	21%
Psychological Personnel	4%
Other (e.g. audio-visual)	8%
	100%

Source: U.S. Department of Health, Education, and Welfare, National Center for Educational Statistics, Digest for Educational Statistics (Washington, D.C., 1975) as cited in Argonne National Laboratory, A Framework for Projecting Employment and Population Changes Accompanying Energy Development, Phase II, August 1976, prepared for the U.S. Energy Research Development Administration, p. 77.

TABLE II-25

GENERAL REQUIREMENTS FOR ROADS & HIGHWAYS

Type of Facility	Function and Design Features	Spacing	Width R.O.W.	Pavement	Desirable Maximum Grades	Speed	Other Features
Freeways	Provide regional & metropolitan continuity and unity. Limited access; no grade crossings; no traffic stops.	Variable; related to regional pattern of population and industrial centers.	200-300'	Varies; 12' per lane; 8-10' shoulders both sides of each roadway; 8'-60' median strip.	3%	60 mph	Depressed, at grade, or elevated. Preferably depressed, through urban areas. Require intensive landscaping, service roads, or adequate rear lot building set-back lines (75') where service roads are not provided.
Expressways	Provide metropolitan and city continuity and unity. Limited access; some channelized grade crossings and signals at major intersections. Parking prohibited.	Variable; generally radial or circumferential.	200-250'	Varies; 12' per lane; 8-10' shoulders; 8-30' median strip.	4%	50 mph	Generally at grade. Requires landscaping and service roads or adequate rear lot building set-back lines (75') where service roads are not provided.
Major Roads (Major Arterials)	Provide unity throughout contiguous urban area. Usually form boundaries for neighborhoods. Minor access control; channelized intersections; parking generally prohibited.	1 1/4 to 2 miles	120-150'	84' maximum for 4 lanes, parking and median strip.	4%	35-45 mph	Require 5' wide detached sidewalks in urban areas, planting strips (5'-10' wide or more) and adequate building set-back lines (30') for buildings fronting on street; 60' for building set-back lines (30')
Secondary Roads (Minor Arterials)	Main feeder streets. Signals where needed; stop signs on side streets. Occasionally form boundaries for neighborhoods.	3/4 to 1 mile	80'	60'	5%	35-40 mph	Require 5' wide detached sidewalks, planting strips between sidewalks and curb 5' to 10' or more, and adequate building set-back lines (30').
Collector Streets	Main interior streets. Stop signs on side streets.	1/4 to 1/2 mile	64'	44' (2-12' traffic lanes; 2'-10' parking lanes)	5%	30 mph	Require at least 4' wide detached sidewalks; vertical curbs; planting strips are desirable; building set-back lines 10' from right of way.
Local Streets	Local service streets. Non-conductive to through traffic.	At blocks	50'	36' where street parking is permitted.	6%	25 mph	Sidewalks at least 4' in width for densities greater than 1 d.u./acre, and curbs and gutters.
Cul-de-sac	Street open at only one end, with provision for a turn-around at the other.	Only wherever practical	50' (90' dia. turn-around)	30'-36' (75' turnaround)	5%		Should not have a length greater than 500 feet.

Source: George Nez, Standards for New Urban Development-The Denver Background, Reprinted by Permission of Urban Land, Vol. 20, No. 5, Urban Land Institute, 1200 18th Street, N.W., Washington, D.C.

TABLE 11-10
CHARACTERISTICS OF SHOPPING CENTERS

	Neighborhood Center*	Community Center*	Regional Center*
1. Major function	Sale of convenience goods and personal services	Some functions of the Neighborhood Center plus sale of shopping goods (wearing apparel, appliances, etc.)	Some functions of Community Center plus sale of general merchandise, apparel, furniture, etc.
2. Leading tenants	Supermarket and drugstore	Variety store and small department store	One or more large, major department stores
3. Location	Intersection of collector streets and secondary roads	Intersections of major roads and/or expressways	Intersections of expressways and/or freeways
4. Radius of service area	1/2 mile	2 miles	4 miles
5. Minimum population to support center	4,000	35,000	150,000
6. Site area (gross land area)	4-8 acres	10-30 acres	40-100 acres and over
7. Desirable maximum size of center as percentage of total area served	1.25% (1 acre/1,000 pop.)	100% (0.75 acres/1,000 pop.)	0.50% (0.67 acres/1,000 pop.)
8. Ranges of gross floor area	30,000-75,000 sq. ft.	100,000-250,000 sq. ft.	400,000-1,000,000 sq. ft.
9. Number of stores and shops	5-20	15-40	40-80
10. Parking requirements***	Parking ratio: 4 to 1 (Parking area is four times gross floor area of building: 400 sq. ft. per parking space) 200-600 spaces 1,000-3,000 spaces 4,000 and over		
**A group of commercial establishments, planned, developed, owned and managed as a unit, with off-street parking provided on the property (in direct ratio to the building area), and related in size (gross floor area) and type of shops to the trade area that the unit serves - generally in an outlying or suburban territory." Definition of the Community Builders Council, ULI.			
**The Community Builders Council, ULI offers the following indicators for types and sizes in Shopping Centers (see Community Builders Handbook, Executive Edition, 1960, page 217).			
Average Gross Leasable Area	50,000 sq. ft.	150,000 sq. ft.	400,000 sq. ft.
Ranges in GLA	30,000-100,000 sq. ft.	100,000-300,000 sq. ft.	300,000 to over 1,000,000 sq. ft.
Usual Minimum Site Area	4 acres	10 acres	30 acres
Minimum Support	7,500-40,000 people	40,000 to 150,000 people	100,000 people
***The CSC recommends a parking ratio of 3 sq. ft. to 1 square foot of gross floor area be used for planning calculations only. For operations the parking index is more realistic (see Community Builders Handbook, Executive Edition, 1960 pages 100-105.)			
Source: George Nez, <u>op.cit.</u>			

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APPENDIX II.B: Bibliography #1 - List of Sources Used to Prepare
This Manual

On the following pages is a partial listing of sources reviewed during this project to prepare the user manual. Other sources are listed after Appendix II A., "Infrastructure Standards" and Appendix I C., "Construction Worker Case Studies." Numerous recommended sources of secondary data are also listed in Chapters 2 through 4 of this manual, which describes the steps for evaluating the secondary impacts of facilities.

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- Volume II - Profile of McLean County, North Dakota, April 1977.
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- Appendix B - Baseline
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- Appendix D - Mitigating Actions
- Appendix E - Alternatives

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On the following pages is a list of the project bibliography developed during an earlier task of this contract. A literature search was used to identify all past research material on models or methodologies for predicting the induced (secondary) land use, socioeconomic, and environmental impacts of industry. The search was directed at both short-term construction and long-term operating effects. The literature were searched for methods that projected not only total growth, but spatial patterns of such growth.

We retrieved 637 citations. These were screened for duplication and relevance, and a total of 32 references were reviewed. These promising sources are listed on the following pages. Our review of each of these sources is summarized in our "Review of Modeling Literature" for the Office of Federal Activities, EPA, under contract WA B064.

In general, it was found that no comprehensive models for predicting induced impacts from industries exist. All models that do address a specific industry are related to energy developments in western boom towns. Where detailed socioeconomic models are available, the input data requirements are so large that their use is prohibitively expensive. Elements of socioeconomic, land use, and environmental impact projection were found scattered throughout the reports. Thus, for the user manual, it was necessary to integrate these elements to produce an induced impacts model which is both informative and scaled to limited agency resources.

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APPENDIX II.D: Glossary

air pollution: the presence of contaminants in the air, particularly at concentrations which interfere with health, safety, or comfort.

air quality: a measure of the characteristics of the air, usually derived from quantitative measurements of the concentrations of specific pollutants.

air quality control region (AQCR): a geographical unit designated by state agencies as the appropriate unit to implement and monitor control strategies. AQCRs may cross state boundaries.

algorithm: a procedure or mathematical formulation which specifies a series of steps to a solution.

ambient: surrounding, e.g., the ambient air.

amortization: to write off an expenditure by prorating it over a fixed period; the amortization period is often equal to the term of the loan used to finance the expenditure.

aquifer: an underground bed or stratum of earth, gravel, or stone that contains water.

area source: a group of point or line sources that individually do not warrant a separate accounting, and which are grouped together as an area source.

areawide environmental assessment: prepared by some EPA regional offices, this document identifies, principally by means of overlays, sensitive features in a given geographic area.

assessed value: the value of land and improvements. This value is established for property tax purposes. Assessed value is not necessarily equal to fair market value.

assessment: the process of forecasting and measuring effects a development project may have on the social, economic, and physical environment.

attainment: a term used to designate an area in compliance with a primary national ambient air quality standard (NAAQS) for a specific criteria pollutant.

average household size: the average number of persons per occupied housing unit.

base map: a map or chart showing the location of important geographic and economic features. These maps are often used as a base upon which additional data of a specialized nature are overlaid.

baseline: the baseline refers to social, economic, or other activity which is forecasted to occur in the absence of the project being reviewed.

basic (economic) activities: activities which produce and distribute goods and services for export to firms and individuals outside of a defined economic region.

carrying costs: the cost to finance an expenditure. As used in this manual, carrying costs include principal plus interest.

central city: 1) a city of 50,000 inhabitants or more which is the core of an urbanized area; 2) the largest city in an SMSA.

coastal zone: as defined in the Coastal Zone Management Act of 1972, the term coastal zone means the coastal waters, and adjacent shorelands, strongly influenced by each other and in proximity to the shorelines of the coastal states. A coastal zone includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches. The zone extends inward from shorelines only to the extent necessary to control shorelands the uses of which have a direct and significant impact on the coastal waters.

coefficient: a number used as a multiplier.

commutershed/commuting radius: the commuting radius is the distance from the site of the facility or project which defines the area from which people may commute to work at the site. Commuting radius may be defined either by distance in miles or by travel time. The commuting area so defined is the commutershed. The commuting radius may not be equidistant in all directions from the site, because of physical or topographical features or boundaries, and therefore the commutershed is not necessarily symmetrical in shape.

comprehensive plan: an official document adopted as a policy guide to decisions about the physical, social, and economic development of a community or region.

criteria pollutants: airborne pollutants which are addressed under Section 108 of the Clean Air Act. These pollutants currently include total suspended particulates, nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone and hydrocarbons. NAAQS have been established for these pollutants.

default value: in this manual, a default value is a value supplied by us for a specific variable (such as average household size) in those cases when you do not wish to calculate a value based upon data for the specific impact area.

demography: the science of population growth and change.

design life: the period for which equipment or a facility can be expected to perform adequately.

direct: see primary.

discounting: used in capital investment decisions, discounting converts future revenues or expenditures to their present value, i.e., their value at the present time. The revenue or expenditure in a future year is multiplied by the present value of \$1 for that year at the required rate of return; the rate of return is also termed the discount rate.

EA: environmental assessment.

economic base analysis: a modeling technique used to estimate future economic and population growth. This technique is the basis for regional income and employment multipliers. Economic base analysis assumes that any regional economy is divided into basic (export-oriented) and service (locally-oriented) firms. Growth in service firms is a function of growth in the basic sector. Growth in the basic sector is a function of population growth, and national and regional economic trends.

economic sector: a group of firms, establishments, or enterprises engaged in similar economic activities. Major economic sectors are agriculture, forestry, and fishing; mining; construction; manufacturing; transportation, communications, electric, gas, and sanitary services; wholesale trade; retail trade; finance, insurance, and real estate; services; public administration.

EIS: environmental impact statement, as defined in section 102(2)(C) of the National Environmental Policy Act of 1969. The Statement is required to cover 1) the environmental impact of the proposed action, 2) adverse environmental effects of the project that cannot be avoided, 3) alternatives to the proposed action, 4) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, 5) any irreversible and irretrievable commitments of resources which would be involved in the proposed action.

emissions: the discharge of air contaminants into the atmosphere.

emission factor: an estimate of the rate at which a pollutant is released to the atmosphere. It is generally expressed as the quantity of pollutants emitted for some unit measure of polluting activity.

emission standard: the maximum amount of a pollutant legally permitted to be discharged from a single source.

employment participation rate: a mathematical expression measuring the percentage of a total population that is employed. It may be derived by dividing total employment by total population or the total civilian labor force.

endangered species: any species identified as rare or endangered by the U.S. Fish and Wildlife Service, State Departments of Fish and Game, the Audubon Society, the National Wildlife Federation, and university departments of zoology, wildlife management, or biology.

environmental assessment: a concise public document for which EPA is responsible which provides sufficient data and analysis to determine whether an EIS or a finding of no significant impact is required. Where EPA determines that an EIS will be prepared, there is no need to prepare a formal environmental assessment. More generally, an environmental assessment can refer to any document which forecasts or measures the impacts of a project upon the environment.

environmental information document: any written analysis prepared by an applicant or contractor for EPA which describes the environmental impacts of a proposed action, or which provides any information necessary for EPA to carry out an environmental review.

evaluation: a determination of the importance of a measured or forecasted impact. Evaluation often implies a selection among several different alternatives.

exogenous variable: a variable the value of which is not determined by the solution of the equations in a mathematical model, i.e., the value of the variable is determined outside of the model.

FNSI: finding of no significant impact. Previously referred to as a negative declaration.

gravity model: a representation of any type of interaction which postulates that the attraction between two areas of activity is a function of a pertinent variable in one, and that this attraction is inversely related to the distance between the two areas.

groundwater: the supply of fresh water under the earth's surface in an aquifer or in soil that forms a natural reservoir.

household: all persons occupying a discrete housing unit.

household formation: the establishment of new households by marriage.

housing unit: a house, apartment, group of rooms, or a single room, which is occupied, or vacant but intended for occupancy as separate living quarters. The occupants of a unit must eat and live separately from other persons in the structure, and must have either direct access to the unit from outside or through a common hall, or have kitchen facilities for their exclusive use. Occupied quarters which do not qualify as housing units are classified as group quarters.

impact area: 1) Level A - the county containing the new facility (the host county), and any county contiguous to the host county; 2) Level B - the county containing the new facility (the host county), and any other counties in the facility's commutershed which are expected to contribute to the facility's labor pool; 3) Level C - all communities within the normal daily commuting radius of the site of the new facility.

incidence: the distribution of impacts among groups or individuals.

indirect: see secondary.

induced demand or impact: 1) new economic activity generated as a consequence of the expansion of other economic activity; 2) any impact caused or brought on by some other activity or impact.

infrastructure: the basic economic and social installations or facilities of a community. Examples include roads, sewers and water supply, schools and public transit systems.

input coefficient: the amount of inputs required from each industry to produce one dollar of output from a given industry.

input-output analysis: a mathematical technique used to describe and predict transactions among industries in a national or regional economy. A basic input-output table is shown on the next page -- this table portrays the flow of goods and services throughout the economy, and provides a means of measuring both the direct and indirect changes in production resulting from a change in demand.

labor force: that portion of the total population over 16 years old and which is not retired. The labor force includes employed and unemployed persons.

labor market area: the geographic area within which the majority of employees engaged in a given economic activity reside. Labor market areas vary by type of activity; for example, construction workers are typically drawn from a larger area than factory workers.

land use map: a map which shows dominant land uses by type of activity, such as residential, commercial/service/retail, manufacturing/warehouse, and public land.

line source: an emission source which follows a linear configuration, such as a road, rail line, or runway. Constant emission rates along the line are not necessarily assumed.

marginal: additional; in economics, 'marginal cost' of a product is the cost of producing one additional unit of that product, and marginal revenue is the revenue derived from the sale of an additional unit.

INPUT-OUTPUT TABLE

	PRODUCERS								FINAL DEMAND (GNP)				GROSS OUTPUT	
	Agriculture	Mining	Construction	Manufacturing	Transportation	Trade	Finance	Services	Other	Personal consumption expenditures	Gross private domestic investment	Net exports		Government purchases
PRODUCERS	Agriculture													
	Mining													
	Construction													
	Manufacturing													
	Transportation													
	Trade													
	Finance													
	Services													
VALUE ADDED (Charges against GNP)	Other													
	Compensation of employees													
	Profit type income* net interest & capital consumption allowances													
GROSS INPUT	Indirect business taxes													

*Excludes corporate income, rental income of persons, corporate profits, and business transfer payments less subsidies, etc.

U.S. Department of Commerce, Bureau of Economic Analysis

- migration: the number of people moving into (immigration) or out of (out-migration) an area over a specified time period.
- mitigation: any technique which minimizes, makes less severe, or moderates a primary or secondary impact of a facility or project.
- model: as used in this manual, a model is a detailed set of relationships, often set down in mathematical terms, intended as a synthetic representation of the behavior of social, economic, or environmental systems. A model is used to test hypotheses or to predict the effects of change in some element of the system.
- (employment/income) multiplier: a mathematical technique used to estimate the impact of a project on a regional economy. The technique is based on the concepts of economic base analysis. A multiplier provides a means of estimating the direct and indirect increase in employment or income resulting from the construction or operation of a facility.
- NAAQS: national ambient air quality standards. The prescribed level of pollutants in the air which cannot legally be exceeded during a specific time (usually either 24 hours or 3 days) in a defined geographic area. NAAQS were mandated by the Clean Air Act Amendments of 1970.
- National Register of Historic Places: a listing maintained by the Heritage Conservation and Recreation Service of architectural, historical, archeological, and cultural sites of local, state, or national significance.
- NEPA: National Environmental Policy Act of 1969. Section 102 establishes requirements for and outlines the contents of environmental impact statements. These statements are to accompany every recommendation or report on proposals for legislation and other 'major federal actions' significantly affecting the quality of the human environment.
- new source: a new source is any source which is constructed or substantially modified after the publication of an emission or effluent standard that applies to that source. All other sources are considered to be 'existing'.
- new source determination: a determination by an environmental reviewer that a facility qualifies as a new source: A new source is defined as "any source constructed after publication of a standard that applies to that source". All other sources are considered to be 'existing'.
- nominal interest rate: the interest rate charged on a loan, as opposed to the real interest rate, which is the true rate after adjustment for inflation. Example: assume a company receives a bank loan at a 20% prime rate, and that the rate of inflation is 12%. The nominal interest rate is 20%, the real interest rate is 8% (20% minus 12%).

nonattainment: a term used to designate an area which is not in compliance with a primary NAAQS for a specific criteria pollutant.

NSPS: emission or effluent standards set for new sources, i.e., new source performance standards.

occupancy rate: the number of persons per room, dwelling, or household.

open space: land that is not predominantly occupied by buildings or structures.

operation area: the area the boundaries of which enclose the site of the facility and its associated infrastructures (such as barge landings, rail sidings, or facilities for self-generation of power).

point source: in air and water pollution, a stationary emitter of large quantities of a pollutant, generally as a result of industrial activity.

pollutant: any material adversely affecting the natural or man-made environment. Noise, light, and radiation can also be considered pollutants.

population density: population per unit of land area, often expressed as either persons or families per acre.

primary impacts or effects: the direct and immediate effects on the social, economic, and physical environment caused by the construction or operation of a facility. These effects are experienced in the immediate vicinity of the project or its related infrastructure. Also known as direct impacts. In economic terms, a primary impact is the first order spending for materials or labor related to the construction or operation of a project.

PSD: prevention of significant deterioration. The PSD regulations, adopted in the 1977 Clean Air Act Amendments and also a required part of all SIPs, divide areas into Classes I, II, and III, Class I having the cleanest air. PSD regulations specify the maximum allowable increases in ambient concentrations of pollutants - these increases are termed PSD increments - for each area, and are designed to prevent a significant deterioration of air quality.

reserve capacity: capacity included in wastewater treatment plants, water supply systems, and other infrastructure facilities beyond that needed to serve current connections. Reserve capacity is, therefore, intended to accommodate future growth.

runoff: the water that flows off of the surface of the land in visible surface streams. Runoff usually refers to the rainfall, melted snow, or irrigation water that flows across the ground surface and eventually returns to a surface body of water. The runoff often picks up pollutants from the air or land and carries them to the receiving waters.

scoping: a process which determines the scope of issues to be addressed in an EIS, and which identifies the significant issues related to a proposed action. See 40 CFR 1500 to 1508, "Regulations for Implementing the Procedural Provisions of NEPA."

secondary impacts or effects: 1) in economic terms, the second and successive rounds of purchases by those firms or individuals which supply the direct requirements of a facility (see direct impacts). In this context, secondary impacts are synonymous with multiplier effects, and include expenditures by households whose jobs or income are traceable to a facility's direct purchases; 2) as defined in Section 1.2 of this manual, secondary impacts of a project or facility are indirect or induced changes in the physical or social environment. Secondary impacts are triggered by direct (primary) impacts. Secondary impacts occur off-site from a project or any associated infrastructure (such as barge landings or rail facilities) which is an essential part of the operation of the project.

service area: the geographic area served by a particular public facility, such as a school, library, police station, or park.

service sector: the service sector for the purposes of Step 15, Level C, includes all retail trade activities (SICs 52-59), and:

- o personal services such as laundry services, beauty and barber shops (SIC 72)
- o automotive repair services and garages (SIC 75)
- o miscellaneous repair services, such as electrical repair, watch repair, or furniture repair (SIC 76).

This definition should be used for Step 15. A good land use map will distinguish retail/commercial/service activities from other activities in an area. At a minimum, retail activities should be broken out of this larger category; it may be difficult, however, to break out the specific services listed above, in which case retail trade activities can be used as an accurate proxy for the service sector.

SIC: standard industrial classification. All firms in the United States are classified by a four-digit SIC.

significant: in impact assessment the term refers to the relative importance of a measured or forecasted impact.

socioeconomic (impacts): refers to social and economic impacts. Social impacts include effects on community cohesion; the stress of assimilation of new population; and increased demand for infrastructure such as schools or hospitals. Economic impacts include direct and indirect employment; expansion of the service sector; or increases in regional spending.

soil loss equation: an equation used to determine the amount of soil which will erode from a given area of land over time under varying conditions of rainfall, slope, soil type, land use practices, etc.

SMSA: standard metropolitan statistical area. Each SMSA is an integrated social and economic unit with a large population nucleus. An SMSA is defined along county lines and must include:

- o one city with 50,000 or more inhabitants, or
- o a city with at least 25,000 inhabitants which, together with contiguous places has a combined population of 50,000.

The largest city in each SMSA is designated as the "central city". In New England, SMSAs are defined along town and city lines, rather than county lines. There is no limit to the number of adjacent counties that can be included in an SMSA, and SMSAs can cross state lines.

state implementation plan (SIP): required by the Clean Air Act Amendments of 1970. National ambient air quality standards (NAAQS) were established for six criteria pollutants (see NAAQS). Each state is required to submit a plan acceptable to EPA which discusses the strategies that will be used to achieve and maintain these standards in regions where these standards are or might be exceeded. EPA will provide a plan for those states which do not develop an acceptable one.

surface water: the streams, lakes, ponds, and oceans which occur on the surface of the earth.

208: the Section of the Federal Water Pollution Control Act (PL 92-500) that mandates areawide water quality management plans.

208 plan: a plan for areawide water quality management completed and implemented by the responsible planning agency ("The 208 Agency").

unemployed person: those persons who did no work, were looking for work, and were available for work during a given period. Also included are those who did no work during the period and a) were awaiting to be called back to work from which they had been laid off, b) were waiting to report to a new job starting within 30 days, c) were prevented from looking for work because of temporary illness.

vacancy rate: the ratio between the number of vacant housing units and the total number of units in an area. The gross vacancy rate counts every empty unit. The available vacancy rate excludes units off the market, and seasonal or dilapidated housing.

VMT: vehicle miles traveled. The total number of miles traveled by all vehicles over a given roadway or on all roadways within a specified area during a given time period.

watershed: the region drained by or contributing water to a stream, lake, or other body of water.

wetlands: land areas characterized by the presence of water at or near the surface during portions of the year; wetlands are characterized by vegetation adapted to wet conditions.

zoning: the demarcation of a city by ordinance into zones and the establishment of regulations to govern the use of the land within the zones.

REFERENCES FOR GLOSSARY

Alan M. Voorhees and Associates. Notebook 5: Environmental Assessment Reference Book. Prepared for U.S. Department of Transportation, 1979.

Jonathan S. Lane, et.al. Impact Assessment Guidelines: The Role of the No-Build Alternative in the Evaluation of Transportation Projects. Prepared for the National Cooperative Highway Research Program, 1977.

Skidmore, Owings, and Merrill. Guidance Notebooks for the Environmental Assessment of Airport Development Projects. Prepared for the U.S. Department of Transportation, 1978.

LEVEL A AND B CASE STUDY

This case study was performed as part of contract #WAB064, "Induced Impacts of New Source Industries: Study and EIS Preparation Manual Development." This contract was sponsored by the Office of Environmental Review, U.S. Environmental Protection Agency.

The principal output of the contract was a user manual for the assessment of secondary impacts of new source facilities under the NPDES program, although the techniques given in the manual can and should be used for environmental review of projects outside of the new source program. The manual consists of a three-level and progressively more detailed analysis of secondary effects. The three levels are referred to as Levels A, B, and C. Level A is the least complex, representing a simple screening procedure, whereas Level C corresponds to that portion of an EIS concerned with secondary impacts. For a more detailed explanation of the rationale for each level, please consult the user manual.

The purpose of this case study is to test the techniques given in the manual at Levels A & B. It would also be desirable to test the Level C techniques; however, the resources available to the contract did not permit this.

We selected a case for which considerable analysis had already been undertaken, but which has not yet and may never be constructed. We wanted to compare the results of the Level A and B analysis with the results of another analysis of the project.

The case selected is the proposed Pittston Company (of New York) oil refinery and marine terminal at Eastport (Washington County), Maine. The company proposes to process up to 250,000 barrels of crude oil per day. This crude will be delivered to the refinery on tankers up to 250,000 DWT capacity. The products of the refinery would be mainly low sulfur heating and industrial fuel oil. A limited amount of gasoline would also be produced.

In performing this case, we worked with data supplied by EPA Region I, by Pittston, by published sources listed in the user manual, and by local sources in Washington County. We did not visit the site of the proposed refinery.

Level A

An essential part of Level A is the collection of data from the applicant and published sources concerning the issues raised in the questions in Figure 1. These questions are included in the user manual. Normally, the user would not ask all of these questions about a proposed facility, but rather would select appropriate questions on a case-by-case basis. However, we have obtained the answer to all 23 questions, for the sake of testing each one.

Figure 1

PROPOSED QUESTIONS FOR SCREENING POTENTIAL SECONDARY IMPACTS (LEVEL A)

1. What is your Standard Industrial Classification number? If more than one SIC applies to your facility, list up to four in descending order of importance.
2. Submit a topographic map of the proposed operation area; this map should extend at least one mile beyond property boundaries. The suggested source for this is a USGS topographical map (1:24,000 scale). You should include the following information on the map:
 - a) the outline of the facility
 - b) the location of each of its proposed and existing intake and discharge structures
 - c) the location of each hazardous waste treatment, storage, or disposal facility
 - d) the location of each well where fluid is injected underground
 - e) the location of all springs, rivers, and other surface water bodies in the map area.
3. Check the categories which best describe the area surrounding the site on which the proposed facility will be constructed, i.e., the area shown on the above map.

☐ Urban	☐ Shopping Center
☐ Suburban	☐ Industrial Park
☐ Small Town	☐ Commercial Strip
☐ Rural	☐ Housing Development
☐ Other (explain)	
4. Submit a more general location map 8-1/2 by 11 inches) which shows town and highway numbers, and which pinpoints the proposed area of operation.
5. Is your facility to be constructed near lands of 25 percent or greater slope? If this information is unknown, consult the topographical map submitted in response to Question #2 above, available from USGS.

Figure 1 continued

6. Are there any sites of historic, architectural, or archeological or cultural value within the impact area? If so, please name them. If this information is unknown, contact the Division of Cultural Resources at the regional office of the Department of the Interior and refer to the National Register of Historic Places, or contact the State Historic Preservation Officer.
7. Are there any endangered species known to inhabit the impact area? If so, name them. If this information is unknown, contact the Office of Endangered Species under the Office of Federal Assistance, U.S. Fish and Wildlife Service at the regional office of the Department of the Interior. Refer to the Federal Register of Endangered Species. Information on marine species may also be obtained from the Office of Marine Mammals and Endangered Species of the National Marine Fisheries Service, which operates under the National Oceanic and Atmospheric Administration.
8. Does the impact area contain a State or federally designated wild and scenic river, or one authorized for further study? If so, please name that river. If this information is unknown, please contact the Heritage Conservation and Recreation Service of the regional office of the Department of the Interior.
9. Does the impact area contain a local, state or Federal recreation area? If so, please name them. If Federal recreation areas are unknown, contact the National Park Service of the regional office of the Department of the Interior.
10. Does the impact area contain wetlands or floodplains? If so, please name them. If this information is unknown, please contact the Environmental Office of the U.S. Fish & Wildlife Service of the regional office of the Department of Interior. State departments for fish and game are also a source for this information.
11. Does the impact area contain significant agricultural lands? If unknown, please contact the Soil Conservation Service at the regional office of the Department of Agriculture.
12. Is any portion of the impact area within a coastal zone? If this is unknown, contact the State Coastal Zone Management Office. (Usually a subdivision of the State Office of Environmental Affairs or Natural Resources Division.) While the state office is a preferable source of information, the Coastal Zone Information Center at the National Oceanic and Atmospheric Administration (NOAA) or the Director of the State Programs Office at NOAA also can provide pertinent information.

Figure 1 continued

13. Does the impact area contain an aquifer or other source of potable water? If this is unknown, contact the State Water Resources Division, which, in conjunction with the United States Geological Survey, broadly maps the aquifers in the state. For a more specific delineation, contact the local Board of Health.
14. Are any mandatory Class I PSD areas located in the impact area? If this information is unknown, contact a) the state air agency, and speak with an individual responsible for the state implementation plan (SIP), or b) the Air and Hazardous Materials Division of the EPA Regional Office that serves your state.
15. Is the impact area attainment, nonattainment, or unclassified in terms of meeting national ambient air quality standards (NAAQS)? If this information is unknown, contact the same sources listed under Question 14.
16. What is the expected employment of your facility when operating at capacity?
17. What is the expected employment of your facility during the peak construction phase? (See Appendix I.C and the last paragraph of Chapter 3, Section 3.8, for a discussion of possible impacts caused by construction workers.)
18. How many employees will have to move into the area to satisfy your employment requirements a) for the peak construction phase, b) for operations?
19. How many new housing units will be required to accommodate the number of employees during the peak construction period?
20. Are there any other businesses of which you are aware that are moving into the area to supply materials to or purchase products from your operation specifically?
21. Briefly describe any anticipated effects on the surrounding area from construction or operation of the facility. These effects might include, but are not limited to: changes in residential or commercial development; changes in land use; etc.
22. Briefly describe any social or economic benefits expected to result from construction or operation of the facility.
23. Are you aware of any significant public objections to construction or operation of the proposed facility? If yes, please describe these objections.

The text which follows proceeds through each question in Figure 1. Please refer to that Figure while reading through the answers to these questions.

- 1) The SIC for the facility is 2911, Petroleum Refining
- 2) Eastport is a small town of about 2,100 persons and Washington County is a rural county with about 32,000 inhabitants.
- 3) and 4) Maps of the site are shown as Figures 2 through 5. All of these maps were provided by Pittston. Note that we have not included a topographical map.
- 5) The facility will not be constructed near lands of 25% or greater slope.
- 6) Twelve landmarks in Washington County are listed in the National Register of Historic Places. Those within a crucial radius of Eastport are:

<u>Name</u>	<u>Location</u>	<u>Date</u>	<u>Distance</u>
a) Barrack's Building of Fort Sullivan	Eastport	1808	N/A
b) Mansion House	Robbinston	c.1800	17
c) St. Croix Island Nat'l Monument	Red Beach	1604	20

Four sites in Eastport are considered by the Maine Historical Preservation Commission as potential nominees to the Register:

- Eastport Central Congregational Church (1829)
- U.S. Customs House (1890-93)
- Peavy Memorial Library (1893)
- Frontier Bank (1882).

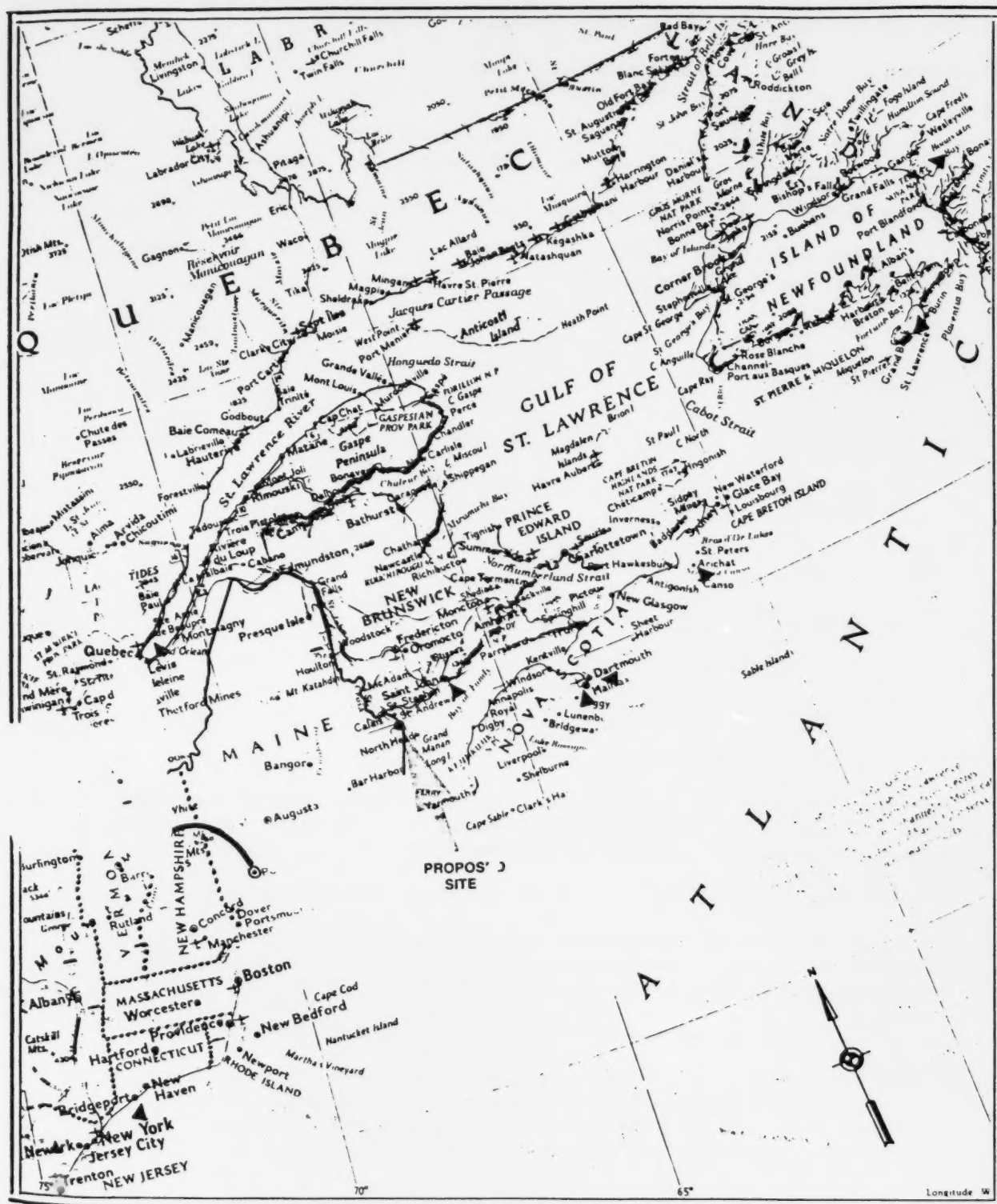
Two other landmarks are historically significant: West Quoddy Head Light House in Lubec, seven miles south of Eastport, and the Roosevelt Cottage, two miles southeast of Eastport on Campobello Island.

No archeological or cultural resources are known in the area.

- 7) Two types of endangered species are known to the region; the Arctic Peregrine Falcon (Fako peregrinus tundris) and the northern bald eagle (Haliaeetus Leucocephalus subspecies Alascanus).

The Arctic Peregrine Falcon migrates along the northeastern coast, and may be found in the Eastport area for short periods of time. Approximately five active nests of 14 northern bald eagles are in the Cobscook Bay area. The eagles use the bay for feeding, and are often seen near the water. While no eagles have been seen specifically on the proposed site, they have been spotted as close as one mile from the boundary of the site.

GENERAL LOCATION MAP



▲ EXISTING REFINERY

SCALE IN MILES
0 100 200

FIGURE 2.

SITE PLAN

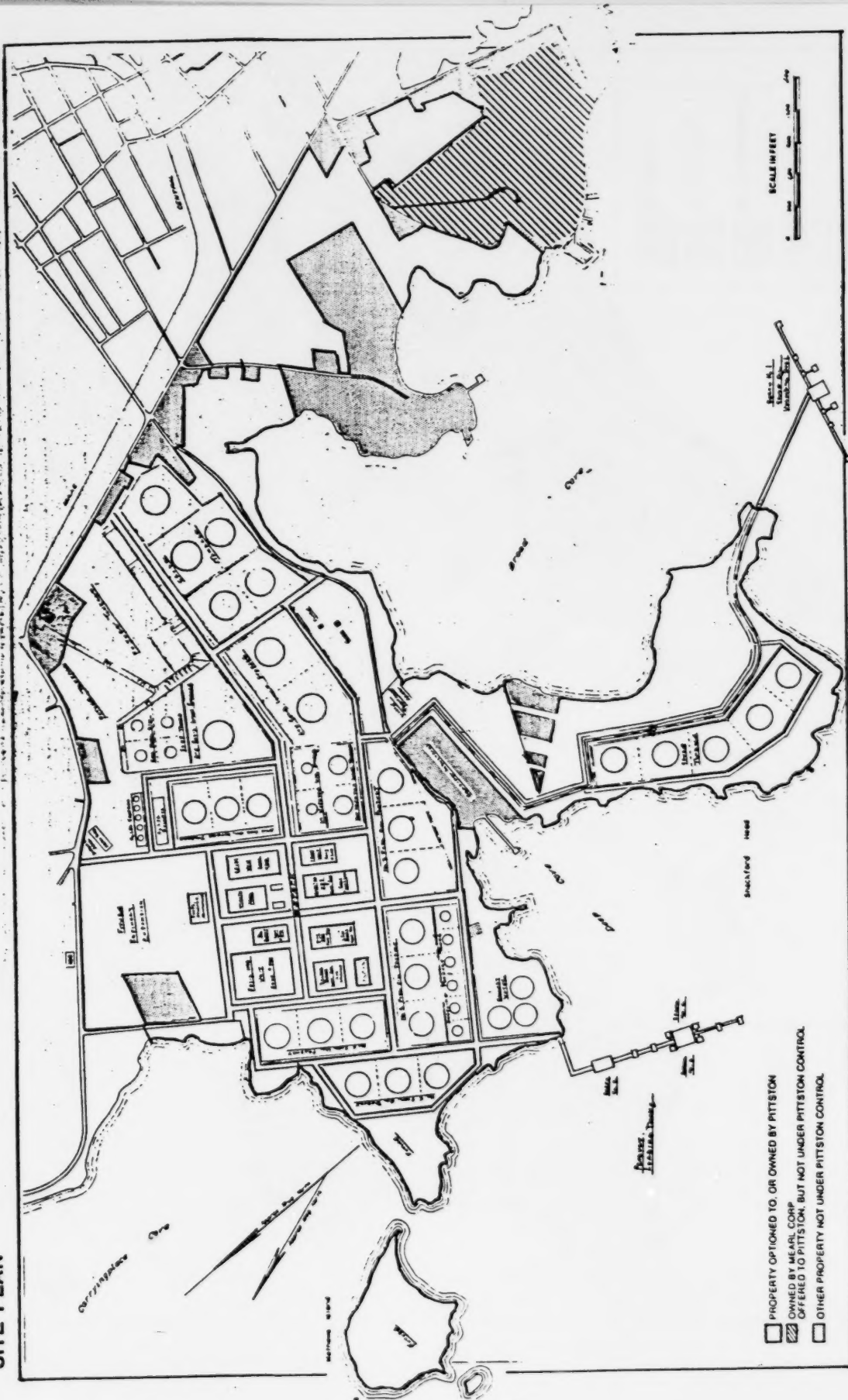


FIGURE 3.

SOIL MAP OF SITE

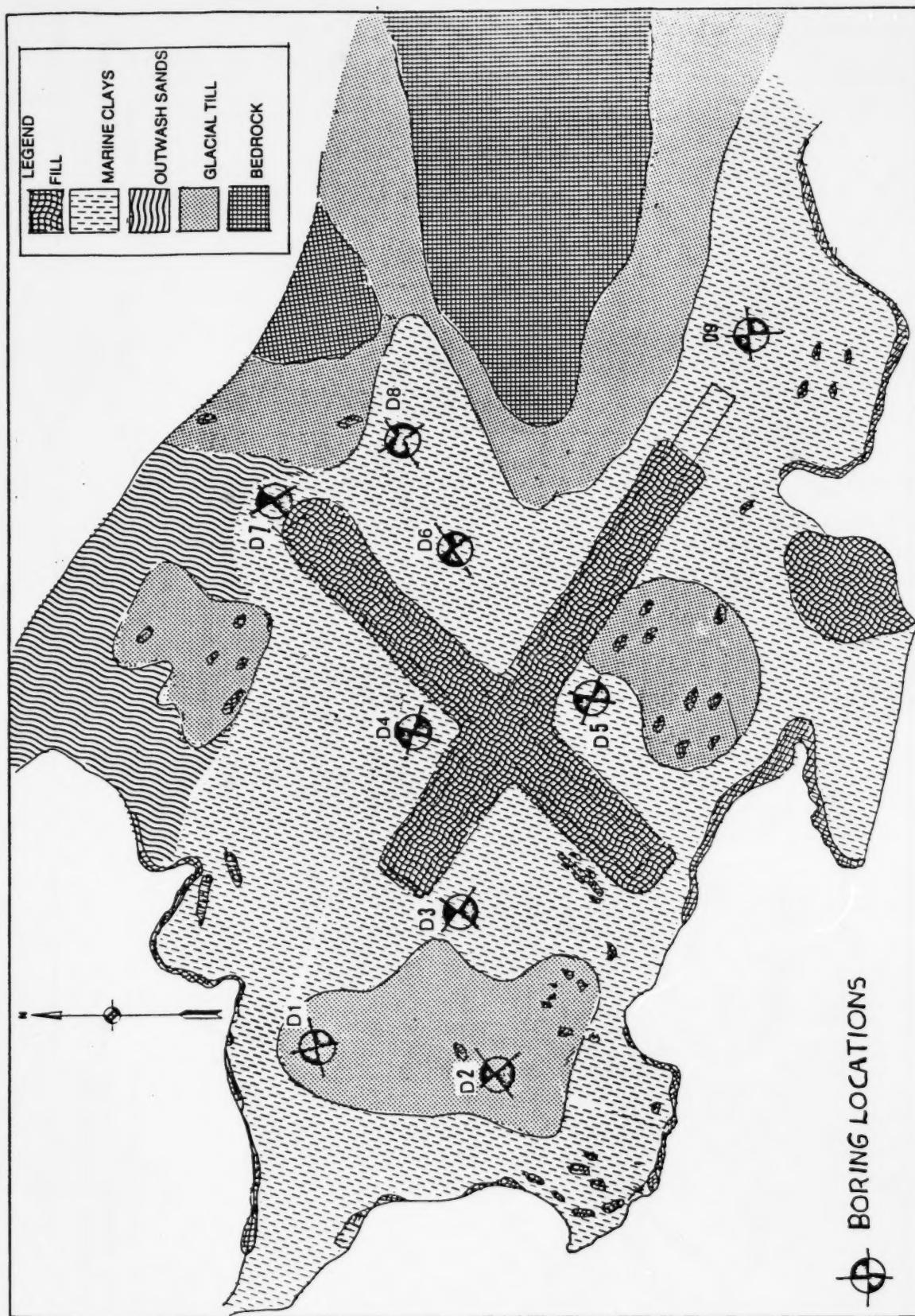


FIGURE 4.

EASTPORT'S SEWAGE SYSTEMS

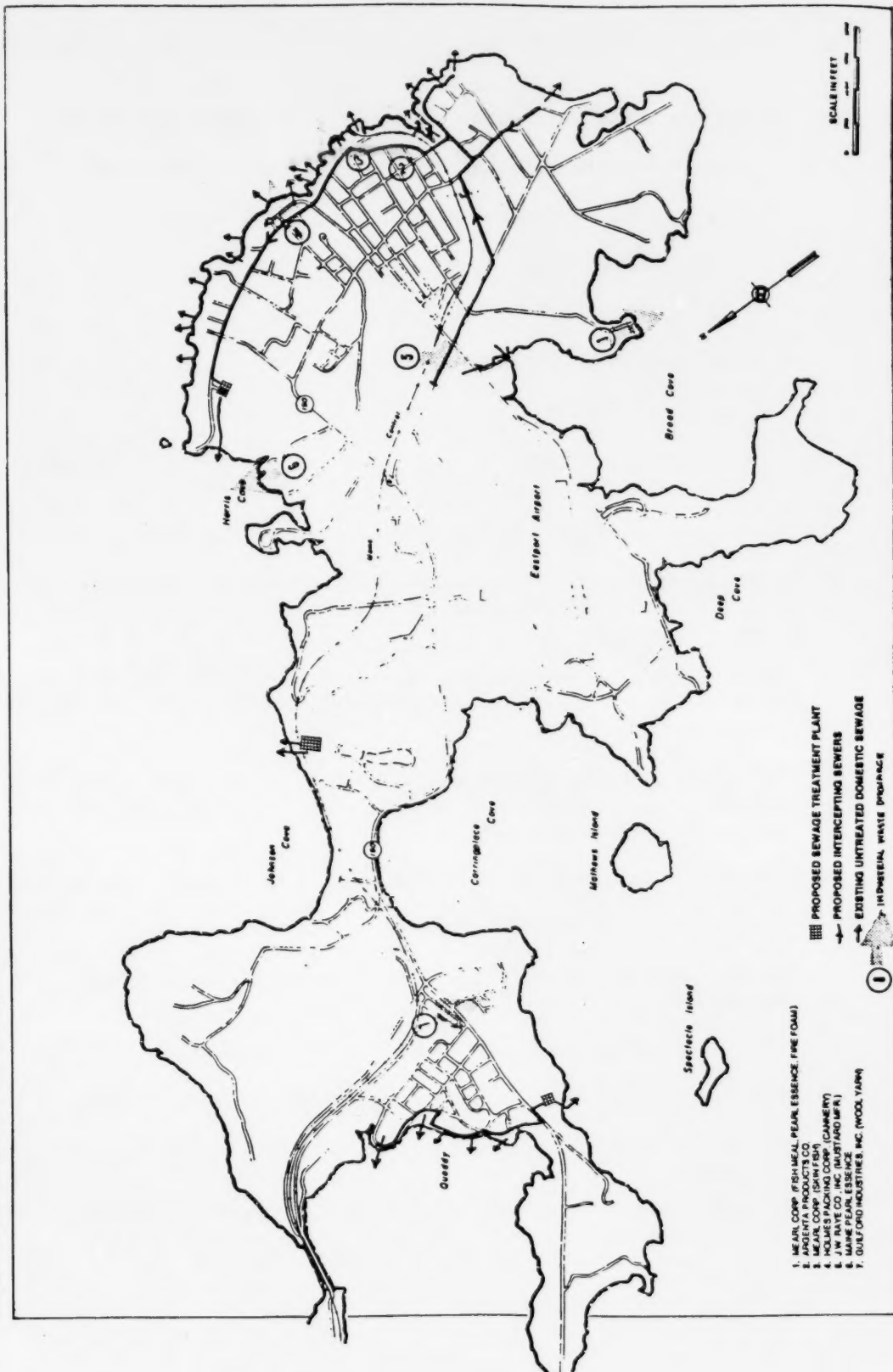


FIGURE 5.

- 8) No state or federally designated wild and scenic areas are within the impact area.
- 9) There are six public park developments in Washington County:
 - Moosehorn National Wildlife Refuge (22,665 acres)
 - Quoddy Head State Park in Lubec (531 acres)
 - Cobscook State Park in Edmunds (868 acres)
 - Gleason Point in Perry (100 acres)
 - Reversing Falls in Pembroke
 - St. Croix National Park in Robbinston.
- 10) The Sunken Bog Natural Area, eight miles southwest of Eastport, is an inland wetland. The impact area contains no floodplains.
- 11) The impact area contains no prime agricultural lands.
- 12) Washington County is a coastal county. Both Eastport and the refinery site are within the Maine Coastal Zone, and are covered by the State's coastal zone management plan.
- 13) Groundwater resources in the region are limited. The only areas that have wells which yield more than 50 gpm are Theyer Ledges, Whiting Township, and Edmunds Township.
- 14) Roosevelt Campobello International Park, about three miles from the proposed refinery, and Moosehorn Wildlife Refuge, about eight miles from the site, are mandatory Class I PSD areas.
- 15) There have in the past been occasional violations of the oxidant standard in the Eastport area. However, Region I feels that the area would not be in violation of the oxidant standard by the time the refinery goes on line, and the refinery itself would not cause any violation. This assumption is based on the implementation of control standards required by the 1977 Clean Air Act Amendments.
- 16) The estimated operating workforce is 300 employees.
- 17) The estimated peak construction workforce is 2,275 workers.
- 18) a) 1,515 non-local workers will be required during the peak construction phase.
b) 100 workers will have to move into the area for operation of the refinery.

- 19) Pittston estimates that about 1,500 non-local workers will be in the Eastport area during the peak construction phase. There are about 300 vacant sale and rental units in Washington County at any one time, and this total has remained constant over the past few years. Assuming that all of these units are suitable, there is a housing deficiency of about 1,200 units in the second year of construction, which represents the peak period.

To deal with this housing deficiency, Pittston plans to build 55 skid-mounted metal buildings as a labor camp to house 1,100 single workers. The company would also renovate 26 existing residences in Quoddy Village that are currently in poor to fair condition; 200 spare rooms could be made available in the area to house workers unwilling to locate in the barracks. Pittston also plans to establish a trailer park of 50 units in Quoddy Village. These units should be more than sufficient to deal with the housing deficiency, assuming that many workers are single and/or willing to house themselves temporarily in this type of housing.

- (20) No other businesses are known to be colocating with the refinery.
- (21) For construction of the refinery to occur, two facilities must be closed: the Eastport Municipal Airport and a camping area. Five houses located on the site may have to be displaced. To shield the refinery from surrounding land uses, a 100-foot buffer zone of trees along the boundary is proposed. The refinery will emit the following pollutants: particulates, nitrogen oxides, nonmethane hydrocarbons, sulfur oxides, and trace amounts of mercury, beryllium, and lead. A continuous emissions monitoring program would be in effect during operation of the refinery. Dredging of approximately 1.45 m cu. yards in the vicinity of the project and crude oil tanker berths will be required. Existing benthic habitats, as well as flora and fauna will be destroyed due to the dredging.
- (22) The greatest social benefit of the refinery is the assurance of a more continuous supply of oil in the event of an embargo, since alternate sources of imported crude oil are more readily available than refined products.

Substantial economic benefits will be realized from construction of the refinery, as the approximate \$645 million expended to construct the refinery will result in increased economic activity. For Washington County alone, a projected net gain of \$17,000,000 - 17,500,000 in income will be realized during the construction phase. An annual income of \$5,200,000 to \$5,400,000 will result from the operation of the refinery.

- (23) There is public concern about the effects of the refinery on the marine ecology, particularly in the event of an oil spill. The safety of tanker navigation through Head Harbor passage is questioned by the public, since tankers will be regularly navigated through the passage to reach the refinery. The potential for a boomtown scenario during the construction of the refinery is a concern to some community members.

Conclusion

Because it is expected that there will be both growth in the local population and a housing deficiency requiring new (although temporary) residential growth, a Level B analysis of the project should be done. This is consistent with the decision criteria in the user manual.

Level B

In the user manual, Level B is presented as a series of steps to estimate population and employment impacts of the facility, with a qualitative assessment of sensitive areas, air, and water impacts. The text which follows conforms to the nine steps in the manual for Level B.

Step 1: Define the Impact Area

Washington County is defined as the impact area, since the county is geographically large enough (2,554 square miles) that the majority of the construction and operating workers can be expected to have temporary or permanent residences in the county. The greatest distance from any point in the county to the proposed refinery is 78 miles.

Step 2: Estimate Direct Employment

While the number of construction workers required at each stage of construction has not been estimated, peak employment will require 2,275 workers. The peak employment is expected to occur for 10 months of the 30-month construction period. The operating workforce of the refinery will be approximately 300 employees.

Step 3: Calculate Nonlocal Employment

As of July 22, 1980, the total labor force in Washington County was 15,992 persons, as reported in Current Population Survey Labor Force Estimates from the Bureau of Labor Statistics. Of the total labor force, 13,801 persons were employed and 2,192 were unemployed for an effective unemployment rate of 13.7%. Pittston anticipates that approximately 1/3 of the peak construction workforce -- 760 workers -- will be from Washington County. This estimate is based on past experience with major construction projects in semi-rural areas.

Since a large number of the jobs involved with construction of the refinery require only a low skill level, and the rate of unemployment is high, the estimate of 760 construction workers from Washington County is reasonable. Of the 300 workers required for the refinery's operation, 200 local workers are expected to be employed, while 100 workers who possess skills not available locally will be imported from outside Washington County. Based on this approximation, the employment increment of the facility,

$$\begin{aligned} E &= E^* - E_{\text{local}} \\ &= 2,275 - 760 = 1,515 \end{aligned}$$

at the peak construction period, and the employment increment over the long-term during operations is

$$\begin{aligned} E &= E^* - E_{\text{local}} \\ &= 300 - 200 = 100 \end{aligned}$$

Step 4: Calculate Indirect Employment

Table 1 exhibits the allocation of employment to basic and non-basic employment. Since detailed employment by sector is not available for Eastport or Washington County, the calculation of a location quotient is based on a comparison of Maine data to national data. The employment data, except for forestry, fishery and agriculture employment, is extracted from the Bureau of Labor Statistics publications Employment & Earnings, and Employment & Earnings, States and Areas. Forestry data are from the United States Forest Service; fishery data are from the National Marine Fisheries Service; agricultural employment for 1977 is forecasted based on Maine data for agricultural employment for 1969 and 1974, as reported in the 1974 Census of Agriculture.

The analysis in Table 1 allows for the calculation of total direct and indirect employment, the implicit employment multiplier, and the direct and indirect population induced by the new source.

Recall $\alpha = \frac{P}{T}$ where P = total population
and T = total employment

$$\text{Thus, } \alpha = \frac{993,772}{505,100} = 1.967$$

where P = state population of Maine as of 7/1/77, as estimated by the Maine State Planning Office.

T = total employment in Maine, 1977.

Recall $\beta = \frac{S}{P}$ where S = non-basic employment.

$$\text{Thus, } \beta = \frac{325,500}{993,772} = .328$$

where S is determined in Table 1.

Total indirect and direct employment, E_T , is calculated as follows:

$$E_T = \frac{E}{1 - \alpha\beta}$$

$$\text{Thus, } E_T = \frac{1,515}{1 - (1.967)(.328)} = 4,270$$

The implicit employment multiplier is $\frac{E_T}{E} = \frac{4,270}{1,515} = 2.818$.

This employment multiplier corresponds to the peak construction phase, which represents only ten months of the three-year construction period. Therefore, this multiplier overstates both the short-term and long-term direct employment effects of the project.

TABLE 1

ALLOCATION OF BASIC AND NON-BASIC EMPLOYMENT,
MAINE AND THE UNITED STATES

(All employment is in thousands)

	MAINE			UNITED STATES			MAINE		
	1977 Emp.	Ratio to Total ME Employment		1978 Emp.	Ratio to Total US Emp		Location Quotient	Basic	Non-Basic
Agriculture	10.3	N/A		2992	N/A		N/A	10.3	
Forestry & Fisheries	2.7	.005		92	.001		5	2.7	
Construction	19.8	N/A		3,833	N/A		N/A		19.8
Manufacturing									
Durable Goods	34.3	.068		11,573	.123		.55		34.3
Lumber & Wood Products	13.6	.027		7,220	.077		.35		13.6
Primary Metals, Fabricated Metals & Machinery	12.7	.025		4,884	.052		.48		12.7
Nondurable Goods	71.6	.142		807	.086		1.65	71.6	
Food & Kindred Products	10.6	.021		1,073	.011		1.91	10.6	
Textile Mill Products	8.7	.017		795	.008		2.13	8.7	
Apparel & Other Textile Products	3.8	.008		1,062	.011		.73	3.8	
Paper & Allied Products	18.1	.036		693	.007		5.14	18.1	
Leather & Leather Products	20.1	.040		253	.003		13.3	20.1	
Footwear, Except Rubber	16.7	.033		156	.002		16.5	16.7	
Transportation & Public Utilities	18.0	.036		4,696	.050		.72		18.0
Wholesale & Retail Trade	83.6	.166		18,492	.196		.85		83.6
Finance, Insurance & Real Estate	15.3	N/A		4,452	N/A		N/A		15.3
Services & Mining	67.5	N/A		16,058	N/A		N/A		67.5
Government									
Federal	17.0	.034		2,727	.029		1.17	17.0	
State & Local	60.7	.120		12,352	.131		.92		60.7
TOTAL	505.1			94,210				179,625	325.5

B=Basic
NB=Non-
Basic
M=Mixed,
either
basic or
non-basic
depending
upon the
location
quotient

The short-term indirect effects are likely to be far less than indicated above. The short-term peak construction period will have a boomtown effect, because economic activity in the town will not expand significantly for the brief peak construction phase of about ten months. The implicit multiplier should be scaled down to account for the short-term nature of the peak. We reviewed a large number of environmental assessments, EISs, and studies of the secondary effects of facility siting. In particular, for boomtowns similar to Eastport, the implicit multiplier typically ranges from 1.2 to 1.5. Using a revised multiplier of 1.5 yields a total net direct and indirect employment of about 2,275.

The long-term effects of the project are attributable to the 100 operating jobs provided to non-local workers. Multipliers of 1.5 and 2.8 yield a range estimate of total net direct and indirect employment of 150 to 280.

Step 5: Calculate Direct and Indirect Population

Recall that the population effect, P_T , is the population impact attributable to both direct and indirect employment caused by the new source, defined as

$$P_T = \frac{\alpha E}{1 - \alpha\beta} = \alpha E_T$$

Thus, short-term $P_T = 1.967(2,275) = 4,475$

Long-term $P_T = 1.967(150) = 295$
to $1.967(280) = 551$

Step 6: Estimate Number of Households

The number of households implied by the direct and indirect population attributable to the new source is

$$HH = \frac{P_T}{H_{av}}$$

where, H_{av} equals average household size, assumed to be 2.9 persons.

The number of households short-term,

$$HH = \frac{4,475}{2.9} = 1,543.$$

The number of households long-term,

$$HH = \frac{280}{2.9} = 96$$

$$\text{to } \frac{551}{2.9} = 190$$

The short-term effects of construction are therefore dramatically higher than the long-term effects of operations.

Step 7: Review Existing Housing Market

A review of data on available housing reveals a vacancy rate of 2-3% in Washington County. The 1970 U.S. Census of Housing reveals 300 vacant units in a stock of 14,021 units, or a vacancy rate of 2.1%. A 1975 Housing Survey by the Washington County Regional Planning Commission estimates a constant vacancy rate of 3% in the county. The survey estimated 267 vacant units in Washington County in 1975.

Contact with realtors in Washington County reveals little significant change in housing availability since 1975. The realtors contacted* estimated the existing vacant units at approximately 300 units. It was noted, however, that the housing market was tighter in the eastern portion of the county, where the refinery would be sited.

Step 8: Estimate New Housing Units Required

Based on information on housing availability, it is reasonable to conclude that 250-300 housing units are currently available to accommodate the population increase associated with the new source siting. These are sufficient to accommodate the number of households attributable to the long-term effects of the project. However, there is a severe deficiency of housing units for the short-term construction peak. This deficiency ranges from 1,250 to 1,300 units, equivalent to about 9.2% of the 1970 housing stock in Washington County.

Step 9: Review Selected Physical Effects

Sensitive Areas

- None of the historic landmarks in Washington County will be affected by the refinery or by probable secondary housing and commercial growth.
- There are two endangered species in the region -- the Arctic Peregrine falcon and the northern bald eagle. The eagles have been spotted as close as one mile from the boundary of the site. The operations of the terminal and the refinery may affect the 14 nesting pairs in the area.
- Transportation of crude oil will be near Roosevelt Campobello International Park. Moosehorn National Wildlife Refuge is about 8 miles from the refinery site, but is not expected to be threatened by residential or commercial growth.
- Sunken Bog Natural Area is an inland wetland eight miles from Eastport. However, the area is not threatened by residential or commercial growth.
- All of the refinery site, the town of Eastport, and the probable site of residential and commercial growth are within the Maine Coastal Zone. There is potential for significant and unpredictable effects from the primary and secondary activities associated with the project. Despite the controls nominally provided by the State's

*Linda Mahon, Mahon Realty & Carlton Small, Strout Realty, both in Eastport.

CZM plan, the refinery is a substantial operation which, if allowed into the Zone, may permanently alter the character of the Zone.

Air Quality

The proposed site is within Maine's Downeast AQCR III, which includes Washington, Hancock, and Penobscot Counties, and is a Class II area. Both Campobello International Park, three miles from the facility, and Moosehorn Wildlife Refuge, eight miles away, are Class I areas.

The refinery will emit significant quantities of various pollutants, including particulates, nitrogen oxides, nonmethane hydrocarbons, and sulfur oxides. However, the final concentrations of all pollutants emitted should not exceed Federal or Maine ambient standards.

The air quality effects of construction will be temporary and localized. The effects of secondary residential and commercial growth, particularly from mobile sources, will be measurable in the short-term, but long-term commercial and residential growth should have a minimal effect on air quality.

Water Quality

Groundwater is not a significant source in the area; rather Eastport's water supply comes from Boyden Lake, which is located on the mainland. Eastport discharges raw sewage and industrial wastes to the bay areas. There are not expected to be any significant primary and secondary impacts on freshwater resources.

Moose Island, the site of the proposed refinery, is surrounded by Cobscook Bay on the west and Passamaquoddy Bay to the east. Tributaries of five rivers and small streams empty into the bays.

Moose Island, Eastport, and other areas where primary and secondary activity would take place are within the Coastal Zone. This area consists of numerous islands, salt marshes, bogs, and other marine features, and it supports a diversity of habitats. There are commercially important communities of shellfish and finfish, as well as species of aquatic mammals, including porpoises and great whales. The coastline and communities are important areas for marine birds. In large part, the success of these species is attributable to the minimal human presence in the area.

The normal refinery discharges will introduce new pollutants to the zone surrounding the discharge points, resulting in an accumulation of oil deposits in the sediment. There is the possibility of oil spills and oil tanker accidents. A tanker accident could have catastrophic effects on the area. These potential primary effects are far more significant than either the short-term or long-term effects of residential or other secondary growth. However, any residential growth in a coastal zone such as Eastport -- which has a limited level of current development -- can have measurable deleterious effects and should be carefully evaluated. Although Eastport plans to revise its comprehensive land use plan to account for the potential effects of the project, we

recommend an independent analysis of the project's secondary effects.

Conclusion

1) During the peak construction phase, there is a projected deficiency of 1,250 to 1,300 housing units, representing about 9% of the total housing base in Washington County. Although Pittston plans to bring in temporary housing, the potential effects of this deficiency require a Level C analysis. This deficiency may result in serious infrastructure overcrowding, secondary physical impacts from mobile homes and stationary source emissions, pressure on sensitive areas, and other effects.

2) The facility site and the town of Eastport, where most secondary growth will be located, are on the coastal zone. The possible impingement of this secondary growth on sensitive coastal areas, combined with the potential primary effects of construction and operation, require a Level C analysis.

Comparison with Other Estimates of Project Effects

A final environmental impact statement has been prepared for the proposed refinery by Region I of the Environmental Protection Agency. Although Level B is not intended to provide the level of detail or level of analysis of an EIS, we have compared the Level B estimates of population and housing effects from this case study to the effects predicted in the EIS.

The EIS distinguishes construction and operations effects. However, the EIS does not look specifically at the 10-month peak period to calculate either population or employment effects. Also, the EIS uses an income, rather than employment multiplier, and calculates employment from the income effects. Therefore, we are not able to compare our peak estimate of employment with the EIS. The EIS does use a multiplier of 1.4, compared with our employment multiplier of 1.5 (our suggested default for a boomtown similar to Pittston is 1.2 to 1.5).

We estimate a total maximum net long-term gain of 280 jobs resulting from the direct and indirect employment effects of the operations phase. This assumes that the 200 jobs filled locally will be taken by individuals who leave other jobs and are not replaced, resulting in no net gain to the area. EPA estimates a net gain of 540 jobs, and assumes that of the 200 filled locally, 180 will be filled by individuals who leave other jobs and are replaced, thereby resulting in a net gain in local jobs.

The EIS does not explicitly calculate the housing deficiency attributable to the peak construction phase, but assumes that Pittston, by providing temporary housing, will meet this deficiency. Recall that we estimated a deficiency of 1,250 to 1,300 units for both peak direct and indirect employment. This is a severe shortage, which cannot easily be overcome, and which may not be resolved by Pittston's plans for temporary units.

The EIS and our case study both agree that the demand for housing by the operations staff and the resulting indirectly employed workers can be met from the available housing supply.

In general, the EIS is more conservative about the peak construction and housing effects on the coastal zone. A Level C analysis, which would be the next step of our analysis, would delve into these issues in more detail, and we could reach some more definite conclusions about the full range of secondary effects.